US Army Corps
of Engineers
Seattle District

Draft

Mud Mountain Dam Upstream Fish Passage Investigation

Volume 1

Supplement Number 3 to Feature Design Memorandum Number 28, to Dam Safety Assurance Program, Mud Mountain Dam, White River, Washington

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EXECUTIVE SUMMARY

Purpose & Need. This Feature Design Memorandum addresses the need, justification and design of a cost effective long-term solution to meet upstream fish passage requirements at the Mud Mountain Dam Flood Control Project. Currently, up stream fish passage is effectively achieved by a trap-and-haul facility located at a barrier structure, approximately 6-miles downstream of the Mud Mountain Dam (MMD) at River Mile (RM) 24.3 on the White River. The structure serves as a fish barrier for the trap-and-haul facility and sufficiently impounds water to supply the trap with gravity flow. In addition to supporting the trap and haul operation, the barrier structure impounds water for a diversion intake for the White River Hydroelectric project, a non-federal facility. Private interests originally constructed the barrier structure and diversion intake in 1910 to divert water for the hydroelectric project. In 1948 the United States Army Corps of Engineers (USACE) entered into an agreement with the current owner of the structure (Puget Sound Energy) to remove their existing fish ladder and replace it with the current trap and haul facility to meet USACE mitigation requirements associated with the construction of MMD. The current structure is at the end of its economic life and is in need of replacement due to reliability, safety, and downstream fish passage concerns. In 1983 Puget Sound Power and Light (now PSE) filed an application with FERC for a major project at the existing facility, which included replacement of the barrier structure. In 1997, FERC issued a license for the project, which was followed by rehearing requests from the federal and state resource agencies as well as PSE. Between 1997 and 2003 PSE continued operation under a stay granted by Federal Regulatory Energy Commission (FERC) while developing a settlement agreement and completing Endangered Species Act (ESA) consultation. In November 2003, due to environmental and other concerns raised during the consultation process, PSE determined that pursuing the license was no longer a viable option. PSE gave the USACE notice that operation of the diversion facility and hydropower would cease at the end of the FERC granted stay on January 14th 2004 and that PSE intended to remove the diversion dam. In response to this action, PSE and the USACE entered into an interim operating agreement, 29 December 2003, under which the USACE would compensate PSE, subject to funding availability, to continue operation of the barrier structure to ensure adequate flows and operation of the fish passage facility until a replacement structure could be constructed.

Alternative Evaluation & Plan Selection. The USACE initiated the current planning and design effort at the request of Congress in 2002. The goal of this effort was to identify a cost-effective, environmentally acceptable, solution to provide and ensure long-term safe and efficient upstream fish passage at Mud Mountain Dam. Under this evaluation, the USACE considered a variety of alternatives including looking at three different locations, and numerous configurations at each location, to provide upstream fish passage for several ESA listed species including Chinook salmon and bull trout and several other anadromous fish species. The alternative evaluation identified a federally preferred plan for further evaluation, which represented the most cost-effective environmentally acceptable solution.

The federally preferred plan is located at the existing diversion facility and includes a 16-foot and 35-foot radial gate, a fixed ogee crest weir, a bypass ramp gate, an upstream levee on the right bank and improvements to the trap-and-haul. This plan does not impact the ability of local

interests to divert flows to Lake Tapps. The total capital cost of this plan is $17.1 million and is described further below. Whereas the objective of the USACE project is strictly fish passage, several local entities expressed interests in the continuation of and improvements to the diversion for recreation, water quality and for a potential municipal and industrial water supply project and potential future hydropower. Pierce County on behalf of these interests requested the USACE also develop plans for a locally preferred plan which would include improvements to the diversion intake and diversion capability in addition to replacement of the barrier structure. The locally preferred plan is largely based on a design developed by PSE in the 1990's which includes a 16-foot and 35-foot radial gates, a bypass ramp gate, two fifty foot inflatable rubber sections and a fixed-crest panel section consisting of three removable concrete panels. The plan also includes similar improvements to the trap-and-haul facility as identified under the federally preferred plan and upstream right bank levee. The total capital costs of this plan is $20.0 million. Local interests would be required to pay for the cost difference between the two plans as project "betterments".

Following independent technical review of the two plans, local interests no longer supported the betterments associated with the local plan and requested the USACE move forward with the federally preferred plan. The federally preferred plan best meets all planning criteria. Final design and implementation of the federally preferred plan will continue to occur under the Dam Safety Program.

Recommended Plan. The recommended plan is the federally preferred plan and includes the construction of a new barrier dam at RM 24.3 on the White River that spans the river channel with an ogee weir, two radial gates (16-foot and 35-foot) and improvements to the trap-and-haul as outlined above. The total cost of this plan is $17.1 million dollars. The radial gates will allow mobilization and passage of sediment and debris as well as maintain supply intake screen capacity and enhance attraction hydraulics for the trap entrance downstream. Gate and ogee crest design will be sufficient to maintain the normal pool level necessary to provide gravity water supply to the trap-and-haul facilities. Training walls extend upstream from the radial gate piers, parallel to the face of the intake. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake, when the gates are operated, enhancing mobilization of sediment and debris. The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet. During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000 cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap operation is optimized. Adjacent to the radial gates, an ogee shaped concrete weir spans approximately 265 feet across the river channel between the radial gate pier and the right bank abutment, replacing the existing flashboard system. The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier. During high flow conditions when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000 cfs tailwater elevation preventing submergence during the river flow range when the trap is operated. Improvements to the fish trap include a sediment control pump, a new 130 cfs supply intake with fish screens, auxiliary attraction water supply with upstream control gates and a new fish ladder entrance with debris handler, and an upgrade

in the holding pool brail. A maintenance deck approximately 15 feet wide will be provided along the axis of the dam to provide vehicular access to facilitate repair and maintenance of the structure and for handling debris. In addition, the maintenance deck may provide access to either bank by serving as a bridge. The maintenance deck will reduce fish transfer time between hatchery and wild fish. A levee on the right bank upstream of the project is also required to address an increase in water surface profiles, the levee will also alleviate current flooding at the Muckleshoot Hatchery. The proposed plan also calls for improvements to access roads and an equipment building. The necessary real estate acquisition for the plan includes a total of approximately 34 acres, including 3.6 acres in fee, adjacent to the USACE's existing real estate interest associated with the trap and haul.

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SECTION 1 -- Introduction

1.1 PROJECT AUTHORITY

The project was authorized as Mud Mountain Reservoir by the Flood Control Act of 22 June 1936, 74th Congress, Second Session. The Flood Control Act of 1938 subsequently provided for operation and maintenance (O&M) of the project by the USACE and the Flood Control Act of 1944 authorized construction and O&M of recreational facilities. Mud Mountain Dam is a single purpose project providing flood control for the lower White and Puyallup River valleys. The existing fish passage facility was constructed as mitigation for the authorized project.

The Seattle District, USACE has been charged by Congress to investigate and design a long-term solution for fish passage around the Mud Mountain Dam. The 2002 Conference Report contained the following language "The conferees have provided an additional $500,000 for the Mud Mountain Dam, White River, Washington, project for the design of fish passage facilities". The Energy and Water Development Appropriation Bill, 2003 in the House of Representatives Report 107-681 provided Construction General Funding under the Dam Safety Account for the Mud Mountain Dam project in Washington to be used to complete fish passage design work initiated in fiscal year 2002. The Energy and Water Development Appropriation Bill in Senate Report 107-220 under Mud Mountain Dam, WA. provided funds to continue work on dam safety measures and the fish passage facility. Appropriation for 2002 and 2003 and subsequent years were provided through the Construction General appropriation under the Dam Safety Assurance Program.

1.2 PROJECT PURPOSE AND SCOPE

1.2.1 Purpose

Seattle District determined that a planning and design report was necessary to address the congressional language with the objective of identifying the least-cost environmentally acceptable solution to provide and ensure long-term safe and efficient upstream fish passage at Mud Mountain Dam. The investigation culminates in this Feature Design Memorandum. Currently upstream fish passage is effectively achieved by a trap-and-haul facility located at a barrier structure, approximately 6 miles downstream of the Mud Mountain Dam (MMD). The barrier dam serves as a fish barrier for the trap-and-haul facility in addition to sufficiently impounding water to supply the trap with gravity water flow. This barrier structure is also integral to the White River Hydroelectric project owned by Puget Sound Energy (PSE) to divert water to the hydropower facility. The barrier structure was originally constructed in 1910 by private interests for a hydroelectric project and is in need of replacement. In 1948 the USACE entered into an agreement with PSE to remove the existing fish ladder and replace it with the current trap-and-haul facility to meet USACE'S mitigation requirements associated with the construction of MMD. The needed replacement of the barrier structure presents an opportunity to assess the method and location for providing upstream fish around MMD. In general, trap-and-haul provides the best means for upstream migrant fish passage around the MMD, yet this study presents an opportunity to evaluate several alternative fish trap locations and configurations. Whereas the objective of the USACE is strictly fish passage, several local entities have interests in the continuation of the diversion for hydropower, recreation, and municipal and industrial water supply. In a letter dated September 4, 2003, Pierce County has agreed to act as the local sponsor on behalf of these interests. Therefore this study not only evaluates alternatives to meet the federal fish passage objective but also presents 35% designs for both a federally and locally preferred plan.

1.2.2 Scope

This report organizes the tasks required for this study into five sections followed by seven appendices. The sections include the following:

- Section 1 – Introduction: This section describes the authority for preparing the document, the purpose for the report, the location of the project, and previous related studies and reports.
- Section 2 – Existing Conditions: This sections presents existing conditions, facilities and features of the project including the White River, MMD, the PSE Barrier Structure, PSE Diversion Intake, USACE Fish Trap, Muckleshoot Fish Hatchery, Right Bank Levee, and Tacoma Pipeline. This section also describes the existing condition for cultural and environmental resources and conditions. Additionally this section describes existing operating conditions with regard to the various groups that share an interest in the project. These groups include PSE (hydropower), Pierce County (local sponsor), the Lake Tapps Task Force (recreation), Cascade Water Alliance (municipal and industrial water supply), Muckleshoot Indian Tribe (fishery), and the various regulatory agencies (environmental).
- Section 3 – Plan Formulation: This section presents the criteria, objectives, and opportunities associated with the preliminary evaluation of 7 alternative plans developed at three different sites. The sites include the existing diversion, a gaging station site (upstream of the diversion), and a site at the base of the MMD. The configuration, operation, and costs are described for each of these alternatives, the alternatives are compared, and an alternative is selected for further consideration as the Federally Preferred Plan.
- Section 4 – Plan Selection - Federal and Local Plans: This section describes the configuration, operation, and costs of the Federally Preferred Plan and the Locally Preferred Plan. The two plans are compared, the cost allocation of the federal responsibility for the project is described, environmental and regulatory compliance is discussed and a recommendation is made to seek approval of the federally preferred plan. Finally the implementation of this plan, including documentation of real estate requirements is described.
- Section 5 – Conclusion: discusses the direction of the 65% design level effort.
- Appendices – Appendices are included for: cost estimating, environmental, hydraulic and hydrologic, geotechnical, design considerations, real estate and structural planning.

1.3 PROJECT LOCATION

Mud Mountain Dam is located at RM 29.6 on the White River, 5 miles upstream and southeast from the City of Enumclaw, and 25 miles east-southeast from the City of Tacoma in western Washington. The existing diversion is located in the City of Buckley, 6 miles downstream of the MMD. This report considers alternative fish trap-and-haul facilities (with barriers) at three different locations. These alternatives are located along a reach of the White River between the diversion and the base of the MMD. Each of the layouts consists of a trap-and-haul facility and various barrier configurations. The initial screening process considers a total of 7 alternatives; three alternatives at the Diversion Dam Site (PSE), three at the gaging Station site, and one alternative with two options at the Mud Mountain Dam Site. These locations are depicted on

Figure 1-1, titled "Fish Trap Sites". Two alternatives, a Federally Preferred and a Locally Preferred, are selected and further developed out of the original seven. Both the Federally Preferred and Locally Preferred alternatives are located at the existing barrier structure.

1.4 PRIOR STUDIES AND REPORTS

Two different types of studies have been performed, which directly relate to this report. The earlier body of studies, reports, and design was performed by PSE throughout the 1990's for the FERC license application. This work includes several technical memoranda and a 30% level design of the diversion upgrade. The latter studies focus on fish passage for MMD by the Seattle District USACE and are included in this FDM. The technical memoranda and reports prepared by PSE of note include:

1.4.1 Final Technical Memorandum No. 1

Final Design Studies, Montgomery Watson, April 22, 1997. The memorandum addresses: armoring of gate aprons, re-use of existing timber crib dam foundation, construction de-watering, downstream scour, and suitability of native material for the levee and cofferdams.

1.4.2 Final Technical Memorandum No. 2

Design Study No. 4 – Scour Analysis, Montgomery Watson, April 22, 1997. This memorandum further addresses downstream scour.

1.4.3 Technical Memorandum No. 1

Background Review, HDR, May 21 1991. This memorandum compiles background information into a concise background report.

1.4.4 Technical Memorandum No. 3

(Draft) Preliminary Conceptual Design Criteria HDR, May 22, 1992. This memorandum presents preliminary design criteria for the project.

1.4.5 Draft Addendum to TM-3,

Final Design Criteria, Montgomery Watson, January 7, 1997: The memorandum addresses final design criteria and serves as an addendum to Technical Memorandum No. 3 (Draft) – Preliminary Conceptual Design Criteria, HDR, May 22, 1992.

1.4.6 Technical Memorandum No. 16

Final Design Report Geotechnical Engineering Services, GeoEngineers, May 2, 1994. This memorandum presents geotechnical design information for the project.

1.4.7 Constructability Review

White River Diversion Dam Rebuild, The Natt McDougall Co., December 1996. This report provides a construction assessment of the project and a cost estimate.

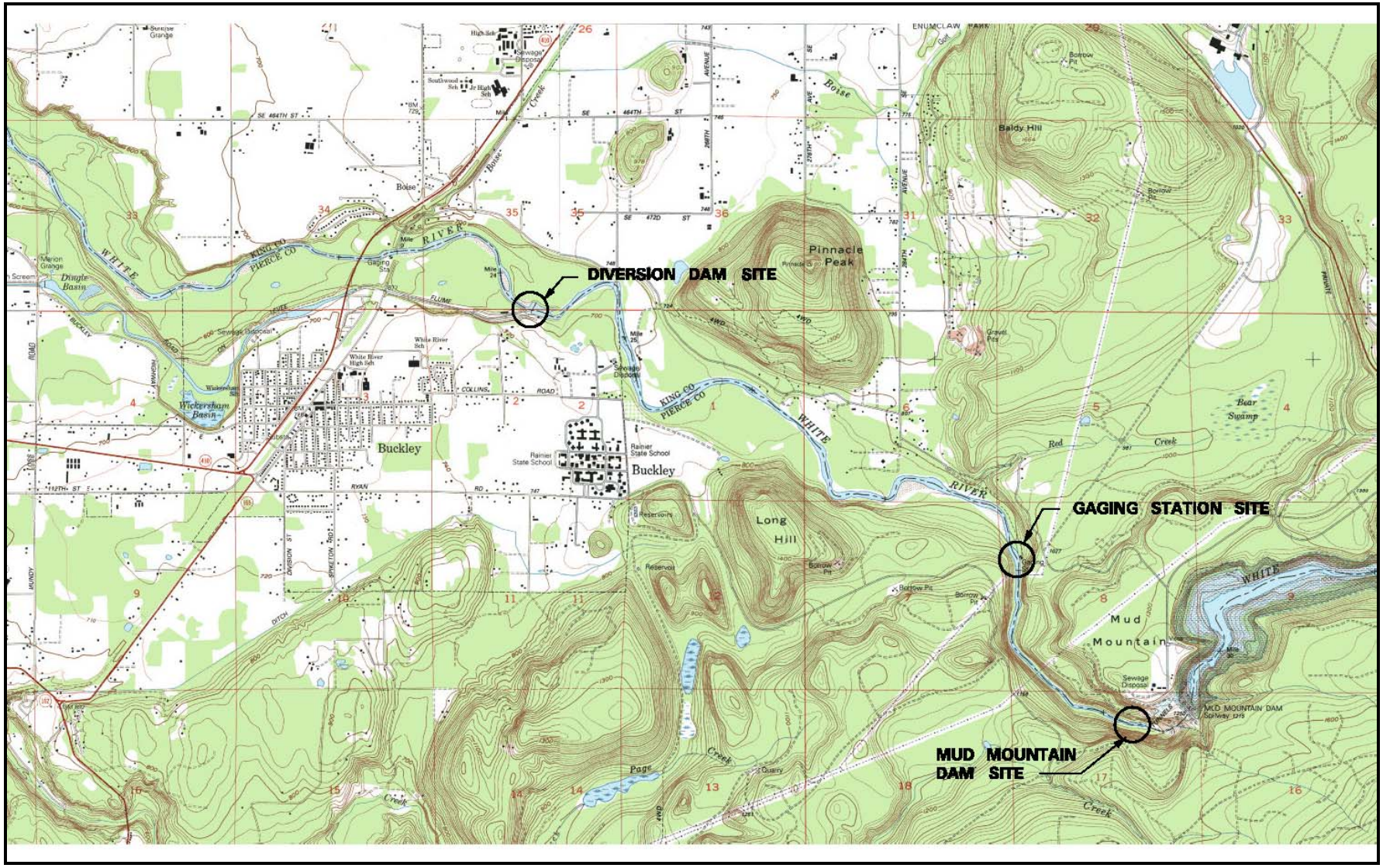

Figure 1-1 – Fish Trap Sites

SECTION 2 -- Existing Conditions

2.1 SECTION OVERVIEW

This section describes the existing or baseline conditions that dictate or influence the development of fish passage planning. This section includes four main focus areas. The first describes important existing features and facilities. The second presents environmental conditions. The third describes important cultural considerations. The fourth and last section describes the 1996 PSE diversion dam and intake design known as the Reference Design, which has been used to varying degrees as the basis for the various barrier and fish trap alternatives.

2.2 EXISTING FACILITIES AND FEATURES

2.2.1 General

There are a variety of facilities associated with the barrier structure. The barrier structure's primary function has been to divert water to the White River Hydroelectric Project. This project includes conveyance to Lake Tapps, storage of water in Lake Tapps, and the release of water back into the river just below the lake. The diversion dam also serves as a barrier to adult upstream migrant fish, thereby allowing for the USACE fish trap to operate. This trap is necessary to provide upstream adult fish passage around the MMD. The Muckleshoot Tribe operates a hatchery on the right bank of the barrier structure. Figure 2-1 (Barrier Structure aerial view) shows an aerial photograph of the facility and adjacent features. The following describes the White River and all relevant facilities.

2.2.2 White River

The Puyallup Basin drains approximately 1,065 square miles and is fed by five glaciers at high elevations on the rugged west and north slopes of Mt. Rainier. The White River, the Puyallup River's principal tributary, rises on the east slope of Mt. Rainier and flows in a general northwest direction 57 miles to enter the Puyallup from the north at mile 10.5, near the City of Puyallup. Mud Mountain Dam (MMD), a federally authorized flood control project, is located at RM 29.6 on the White River. The Carbon River enters the Puyallup at RM 17.9 and is the second major tributary to the Puyallup. The Puyallup River enters Commencement Bay in the city of Tacoma.

Prior to 1906, the flow of the White river split into distributaries near Auburn, with some flowing north toward the Green River and some in a southerly direction toward the Stuck River, which then drained into the Puyallup. In 1906 flooding and human activities resulted in the entire flow of the White being channeled to the Stuck River. This diversion resulted in the lower 25 miles of the Puyallup River and the lower 8 miles of the White (Stuck) needing extensive flood control in the way of levees, dikes, channelization, and stream straightening.

During the warmer seasons the runoff from glacial melting on Mt. Rainer results in high river turbidity of a cloudy white color. The river reach of interest extends from the PSE diversion at RM 24.3 approximately 6 miles upstream to the base of the MMD (RM 29.5). Flow in this reach is monitored at the USGS gaging station No. 120985500 (RM 27.9). The drainage area at this point in the river is 401 square miles. High sediment conditions and bedload movement in the river occur during flooding, which tends to occur in the late winter and early spring.

Figure 2-1 Barrier Structure Aerial View

2.2.3 Mud Mountain Dam

Mud Mountain Dam is a single-purpose flood control facility providing flood protection to the lower White and Puyallup River Valley. Project components of the federally authorized project are described below.

2.2.3.1 Description:

(a) Dam: The dam is a zoned earth and rock-fill structure with a 810-foot-long crest and a maximum height of 432 feet above bedrock. The structural height of 427 feet is measured from the bottom of the structural depression located approximately 170 feet upstream of the cutoff wall to the top of dam at 1257 feet. The dam is 1,600-feet-wide at the base, 25.5-feet-wide at the crest, and the design crest elevation is 1257 feet. A concrete seepage cutoff wall extends from the crest into bedrock in the core of the dam. Mud Mountain Dam is constructed in a narrow canyon where rock walls on both sides of the gorge rise almost vertically to a height of nearly 275 feet above the White River channel.

(b) Spillway: The spillway, an uncontrolled chute converging from a width of 315 feet at the crest to 120-feet-wide at the bottom in a

distance of 620 feet, is located in the right abutment of the dam and terminates in a flip bucket 180 feet above tailwater. The trapezoid-shaped chute, which is concrete lined on the floor and about 30 vertical feet up the walls, discharges through a flip bucket directly into the canyon about 500 feet downstream from the toe of the dam. The discharge capacity at spillway design flood pool elevation, 1232.2 feet is 24,500 cfs.

(c) Intake Tower: The original 9-foot and 23-foot intake towers were replaced with a single intake tower containing an entrance to the 9-foot-diameter tunnel and dual entrances to the 23-foot-diameter tunnel. The intake tower consists of a low flow entrance structure and trashrack to elevation 960, a main upper trashrack structure to elevation 1100, a gate chamber structure to elevation 1040 and an airshaft on top of the gate chamber to elevation 1260. The trashrack is designed to prevent passage of debris in excess of about 3 feet in diameter. Radial-type service gates control passage through either the 9-foot or 23-foot-diameter tunnels. Vertical lift roller type gates provide emergency closure for both the 9-foot and 23-foot-diameter tunnels upstream of the service gates.

(d) Tunnels: Nine-foot and 23-foot-diameter tunnels pass flow controlled by radial gate valves into the White River below. A training wall directs flow into the confines of the river channel. The 9-foot-diameter tunnel is pressurized above 2,000 cfs. The radial gates provide open channel flow characteristics in the 23-foot-diameter tunnel at all pool elevations. The tunnel gate control section has a capacity of approximately 24,800 cfs at a pool elevation 1215 feet; however, discharge will normally be controlled to a maximum of approximately 13,000 cfs except for emergency, dam-threatening conditions. Downstream fish passage is predominately through the 9-foot-diameter tunnel, although both tunnels are designed to pass out-migrating fish.

2.2.3.2 Operation: The MMD is operated by the USACE to provide flood control. During winter flood control season, (1 October through 31 March) the reservoir will be empty with the project on free flow to provide approximately 106,000 acre feet of storage for use in regulating floods. Flow at the dam normally passes unregulated through 9-foot and 23-foot-diameter tunnels under the dam. Regulation through two tunnel inlet structures (constructed in 1994) occurs when flow at the USGS Puyallup Gage is forecast to exceed 45,000 cfs. During flood events releases are limited to 200 cfs until the Puyallup Gage flow drops below 45,000 cfs, except during large floods, when discharge will be increased to best utilize remaining reservoir storage. A secondary objective is to reduce damage in the White River reach between the dam and the mouth of the White River by limiting dam discharge to 12,000 cfs when feasible. Dam discharge will be increased on the rising side of the flood hydrograph to preserve storage for Lower Puyallup river flood control to a limit of 12,000 cfs.

2.2.4 PSE Barrier Structure

The PSE barrier structure, located at RM 24.3 on the White River was constructed between 1910 and 1912. It was built to divert up to 2,000 cfs from White River, into the flowline

for the White River Hydroelectric Project. The barrier structure consists of a rock and concrete timber crib structure with 4-foot high flashboards on top to achieve an 11-foot overall height. Concrete dam abutments are included at each end. Flow in excess of 4,000 cfs collapses the flashboards, which are difficult and labor intensive to re-install. Flashboard installation requires manual in-river work at the edge of the dam and by using a trolley system over the structure. At times flashboard installation also requires flow manipulation at MMD. The work can cause concerns related to fish stranding even with established ramping rates.

2.2.5 PSE Diversion Intake

The diversion intake is located on the left bank of the river and is controlled by two vertical roller gates. The existing water right allows for up to 2,000 cfs to be diverted from the river, however minimum instream flow requirements limit the diversion during low river flow. This diversion is prone to high bedload buildup both at the inlet to the diversion and behind the flashboards. Rock flushing back into the river is performed just downstream of the existing headgate to limit the accumulation of cobbles in the flume. The flashboards back water up into the diversion intake.

2.2.6 USACE Fish Trap

2.2.6.1 General: The fish trap-and-haul facility for MMD was constructed on the left bank of the diversion dam in 1943 as mitigation for the authorized project. The USACE entered into an agreement with the owner of the facility in 1948 which provided necessary real estate for removal of an existing fish ladder, construction of the trap-and-haul facility, and provided access for operation and maintenance. The trap is used to pass adult summer and fall Chinook, coho, and steelhead to the river reaches above MMD. Trapped hatchery spring Chinook are moved to the Muckleshoot hatchery located on the right bank of the barrier structure by tribal officials. All other fish are returned to the river at a site located approximately 5 miles upstream of MMD at RM 35. The barrier structure provides a water level differential that allows the trap-and-haul and fish ladder to operate with gravity flow. The original design allowed auxiliary flow to be introduced both at the entrance pool and upper diffusion pool, however current operations introduce flow into just the holding and loading pools. Fish trap flow ranges from 25 to 35 CFS. The brail used for crowding fish from the holding pool into the loading pool is fabricated from wood and is periodically refurbished.

2.2.6.2 History: When the original fish trap began operating in 1948, its objectives were simple. The trap was designed to allow for efficient collection and transport of wild adult salmonids of the White River upstream of Mud Mountain Dam. The trap was therefore built to minimize the effort and time required by government personnel to meet that single objective.

2.2.6.3 Other Uses: Since its construction, trap uses have expanded with the first changes occurring after construction of the White River Fish Hatchery. After the hatchery was constructed, it became a common practice for state and tribal representatives to separate hatchery Chinook from wild Chinook at the fish trap. Around that same time, federal, state and tribal biologists started to take advantage of the trap as an opportunity to measure, tag and collect other biological data on adult salmon. The White River Trap is still used today by biologists to support research efforts on steelhead, Chinook and bull trout.

Lastly, the current fish trap serves as a central source of population data for escapement trends as the adult return numbers are enumerated and then forwarded to various agencies. Each of these other uses are incidental to the authorized purpose of the trap-and-haul facility.

2.2.6.4 Fish Trap Performance: During this evolution of purpose, the trap has remained an efficient collector of salmon. It has been proven capable of collecting returning adults during the heaviest of runs as evidenced by the low occurrences of fish jumping at the diversion barrier and lack of heavy accumulations of fish at the forebay. In 2003, over 13,000 pink salmon returned to the trap in coincidence with a large return of 15,700 coho. Pink salmon are generally considered weak swimmers compared to coho, Chinook, steelhead and bull trout. Still, the number of pink salmon that returned to the trap was evidence that pink salmon could successfully find and negotiate the fish trap at Buckley. The largest point of concern regarding trap efficiency is not whether it can collect fish, but that existing transportation methods can become strained. This can be remedied by changes to the number or capacity of fish transportation vehicles. It is not considered a trap constraint.

2.2.6.5 Fish Trap Concerns: The only trap related concern lies with the potential for injury or harm during fish movement or during the waiting period. Potential injuries have been found from discrete conditions identified within the trap ranging from extended bolts, overhanging sill plates and eroded brail sections. To date, each of these conditions have been addressed and physical injury to adult salmon from any portion of the trap is extremely rare.

2.2.6.6 Fish Trap Design Considerations: This FDM focuses on modifications that are necessary to ensure the continued unabated operation of the fish trap.

2.2.6.7 Fish Trap Physical Details: This information is based on the 1947 USACE Design Drawings. Figure 2-2 titled “Fish Trapping Facilities” depicts the original configuration of the existing fish trap-and-haul facility. The following sections provide details of the existing trap configuration.

(a) Tailwater Conditions: Tailwater range at entrance for efficient fishway operation:

i) Min TWEL 658.5

ii) Max TWEL 662.5

(b) Entrance Pool:

i) 12-feet-wide by 23-feet-long

ii) Minimum normal volume = 1,158 cubic feet (w/ weir gate in down position, 1 foot of head)

iii) Diffuser grating: ¾-inch by 4-inch bar grating w/ rounded ends in profile, 1 inch slot (1¾ inches o.c.)

iv) Sluicing system – piping under diffuser grating for sluicing sediment, 4-inch diameter header/manifold, and 8 nozzles per pipe oriented vertically downward at auxiliary water supply floor.

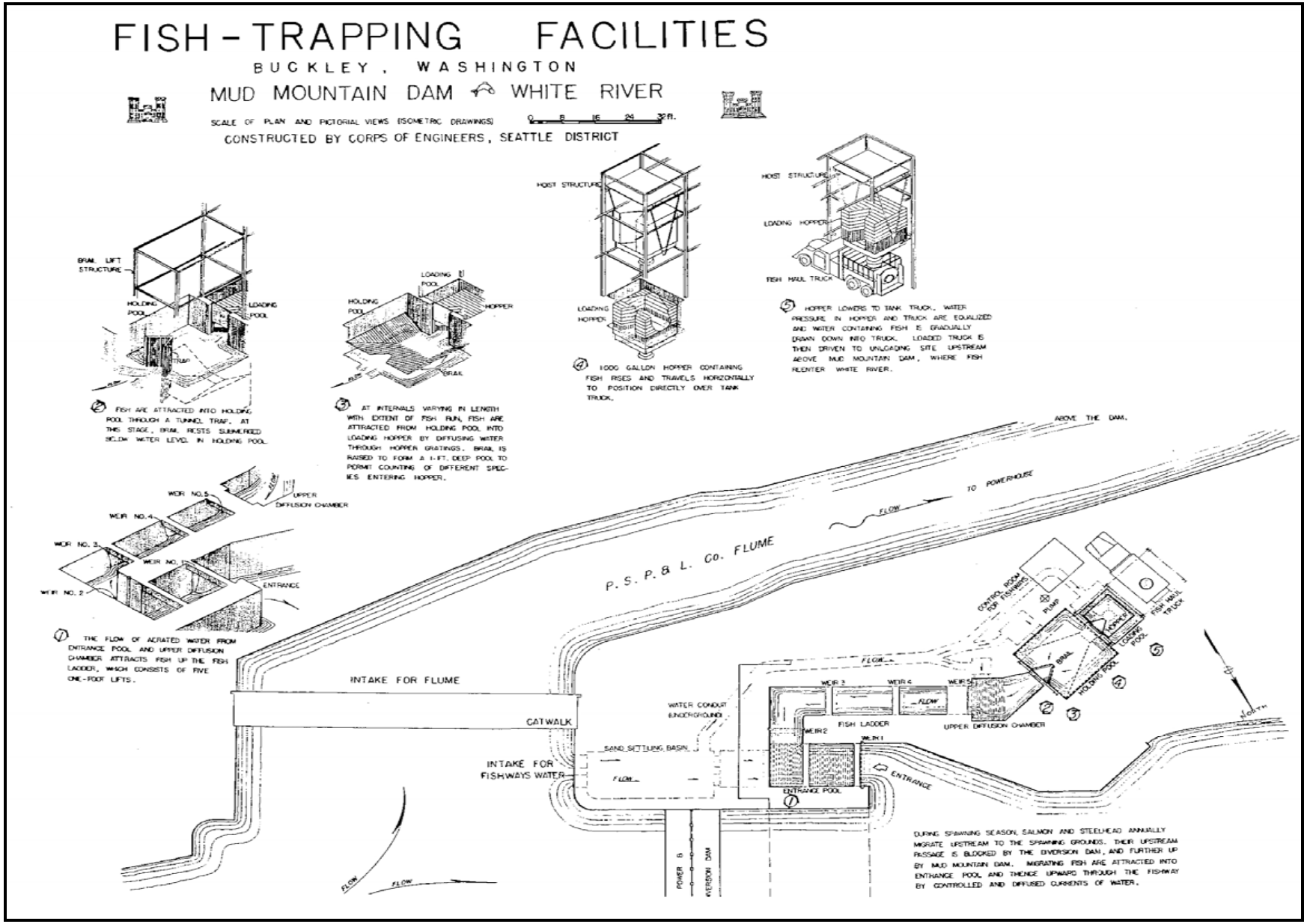

Figure 2-2 Fish Trapping Facilities

(c) Ladder

i) Pool-and-weir type ladder

ii) 2 right-angle turns

iii) 5 weirs

iv) No orifices

v) Crest Breadth = 0.5 foot with rounded corners

vi) Normal Head = 1.0 foot (depth over weir)

vii) Normal Operating Q = 27 cfs (1 foot of head)

(d) Weir #1

i) Weir Height = 4.5 feet (above diffusion grating)

ii) Crest Length = 8 feet

iii) Crest Breadth = 0.5 feet with rounded corners

iv) Weir crest fixed EL 658.5

v) Baffle length = 4.0 feet

vi) Baffle crest fixed EL 659.5

vii) Normal Low Operating Q = 27 cfs (1 foot of head, 8 feet effective weir length)

viii) Normal High Operating Q = 40 cfs (1 foot of head, 12 feet effective weir length)

(e) Weirs #2 through #4

i) Weir Height = 5 feet

ii) Crest Length = 8 feet

iii) Crest Breadth = 0.5 feet with rounded corners

iv) Step Height = 1 foot

v) Full width, level crested weirs

vi) Respective Fixed Crest EL's 659.5, 660.5, 661.5

(f) Weir #5

i) Weir Height = 4 feet

ii) Crest Length = 8 feet

iii) Crest Breadth = 0.5 feet with rounded corners

iv) Step Height = adjustable

v) Fixed Crest EL 661.5

vi) Adjustable crest weir gate with finger trap into Upper Diffusion Chamber

(g) Pools (between Weirs 2 and 5)

i) 15-feet-long by 8-feet-wide

ii) Sloping floor drops 1 foot along length of pool

iii) Min volume = 540 cubic feet (0 feet depth over weir)

iv) Normal volume = 660 cubic feet (1 foot depth over weir)

(h) Weirs #1 Gate

i) Adjustable crest weir gate

ii) 12-feet-long by 4.25-feet-high

iii) Rounded, level crest

iv) Min gate crest EL 658.5

v) Max gate crest EL 666.0

vi) Manual operated, hand winch

(i) Weirs #2 Gate

i) Adjustable crest weir gate

ii) 8 feet-4¼ inches long by 3.5 feet high

iii) Rounded, level crest

iv) Min gate crest EL 659.5

v) Manual operated, hand winch

(j) Weirs #3 Gate

i) Adjustable crest weir gate

ii) 12-feet long by 4.25-feet high

iii) Rounded, level crest

iv) Min gate crest EL 662.5

v) Manual operated, hand winch

(k) Finger Trap for Weirs #3 Gate

i) Attached to upstream face of weir gate

ii) ½-inch dia bars @ 1½ inches o.c.

iii) Each bar is shaped into ¼-circle oriented upstream

iv) Finger trap has a 6-inch vertical range of adjustability independent of weir gate

v) Height range above weir crest = 8.5 inches to 14.5 inches

(l) Upper Diffusion Chamber

i) 8-feet-wide by 6-feet-long rectangular area plus an 8-foot-long tapered, dog-legged transition to holding pool entrance

ii) Supply water from 2.5-feet by 5-feet port in side wall at floor below grating

iii) Diffuser grating in floor over rectangular section for auxiliary attraction flow

iv) Same grating used for entrance pool

v) Sluicing system similar to that for entrance pool

(m) Holding Pool

i) Dimensions: 18-feet-square, approximately 10 feet submerged depth.

ii) "Tunnel Trap" entrance: Formed from vertical bars, 6 feet in height, Tapers from 5 feet wide to 0.5 feet wide, Narrow gap can be closed with manual slide gate leaf

iii) Braille: Floor grating similar to that in entrance pool, Tapered and sloped floor plan from trap to loading pool, Sloped sides from wall to floor on either side of sloped floor, Can be raised to funnel fish into loading pool

iv) Holding Capacity: The capacity of the existing holding pool is 3,240 cubic feet with a flowrate of 25 to 35 cfs. Based on the holding volume criteria presented in section 2.3.2.9, 2.6 lbs of fish per cubic foot can be held. Therefore the volume criteria allows up to 562 Chinook salmon, at an average 15 pounds per fish (the heaviest fish of concern). Flow criteria presented in Section 2.3.2.10 allows for 0.4 gpm per fish or 4,488 to 6,284-fish. Note the stated capacity of 250 fish is met.

(n) Loading Pool

i) 9 feet-2 inches by 15 feet-6 inches

ii) Supply water from 2-foot by 2-foot port in side wall at floor.

iii) Sluicing system similar to that for entrance pool.

(o) Fish Elevating Hopper

i) 8 feet by 8 feet, with funnel shaped floor

ii) Circular valve at bottom to release fish into tanker truck

iii) 3 feet-6 inches deep "bucket" (valve to bottom of pickets).

iv) 3-feet-high, 1-inch by 4-inch pickets at 1¾ inches O.C. above "bucket" around perimeter and forming V-trap at entrance from holding pool.

v) V-trap entrance similar to that in holding pool entrance.

vi) Solid wooden walls above pickets.

vii) A hoist and gantry crane are used to raise, lower and move the hopper laterally.

viii) As the hopper is lifted, water escapes through the pickets leaving only the volume within the bucket.

ix) Fish are transferred to tanker trucks by raising the hopper, moving it laterally, lowering onto the tanker trucks, and opening the valve to drain the water and fish into the tank.

(p) Supply Water Intake and Distribution System: Supply water is drawn from the PSE canal via two 3.5-foot-square gated orifices in the right wall of the canal intake near its upstream end. Orifice IE's 663.5.

(q) Min HWEL 667.0 for supply water flow.

(r) Trashrack - A coarse trashrack (4-inch by ½-inch bars @ 3 inches O.C., 2.5-inch gaps) is positioned in front of the gated supply water intakes.

(s) Supply water discharge - The supply water is discharged into a 30-foot-long by 12-foot-wide sand settling basin.

(t) Trashrack - A fine trashrack (4-inch by ½-inch bars @ 1.5 inches O.C., 1.0 inch gaps) is positioned within the sand settling basin.

(u) Water Disribution - Water is distributed from the sand settling basin to the various demand points within the fish ladder and trap facilities via underground conduits.

i) Gates at the end of each of conduits control flow rates into each of the respective demand points.

2.2.7 Muckleshoot Fish Hatchery

A fish hatchery, operated by the Muckleshoot Indian Tribe is located on the right bank of the barrier structure. The Muckleshoot fish hatchery began operation in 1989 for the production of spring Chinook. This hatchery has a fishway entrance/outlet located at the right downstream bank of the diversion dam. Water for the hatchery is supplied by both wells and a river intake located approximately 2,000 feet up the river from the diversion. The river intake was upgraded with a new inlet structure, a pump station, and a levee during the mid 1990's. The capacity of the combined supply is 5 to 10 cfs. The hatchery water right is 12 cfs. Currently the fishway entrance/outlet is prone to blockage by bedload and requires that a channel be dredged out periodically to maintain the flow path. Attraction flow for this entrance is insufficient. The trapping of adult fish requires manual netting and handling due to inadequate performance of the loading hopper system.

2.2.8 Right Bank Levee

The Muckleshoot hatchery is protected from flooding by a relatively low levee along the right bank of the river upstream of the diversion dam. Minor sandbagging of the levee has been necessary at a weak point in the lower section of the levee to prevent flooding in the past. The upper section of the levee, approximately 400 feet east of Mud Mountain Road, was substantially upgraded as a part of the hatchery water supply pump station improvements.

2.2.9 Tacoma Pipeline Crossing

A major water transmission pipeline for the City of Tacoma crosses the White River approximately 1 mile downstream of the diversion dam. Up until September 2003 the pipeline obstructed the river with the concrete encasement acting as a weir and posing a barrier to pink salmon. Work to lower the pipeline to below the riverbed and remove the obstruction has been completed. There was concern that removing this feature would impact the tailwater conditions at the diversion dam. Recent hydraulic evaluation of the reach, using HEC-6, suggests that changes in the tailwater curve below the dam may occur. Discussion of the model is found in Appendix C – Hydraulic and Hydrologic. It does not appear that the lowered tailwater will affect the ability of the barrier dam to exclude salmon. However, it may require additional design work to assure that the fish ladder entrance is not stranded. The original pipeline crossing may have inhibited the passage of pink salmon, known to be weak swimmers. The removal of the old pipeline crossing obstruction may increase the occurrence of pink salmon at the trap-and-haul facility.

2.3 Environmental Considerations

2.3.1 Physical Environment

The valley of the White River in the project area is cut mainly in a series of Pleistocene material, which include glacial outwash, lake deposits, ancient volcanically generated ash beds, mud flows, and related fluvial deposits from Mount Rainier. The river is glacier fed and naturally turbid. The high turbidity is a result of large amounts of glacial flour which gives the river its characteristic white color. Air quality in the project area is excellent. Routine and temporary releases of carbon dioxide and other compounds are common from project machinery and equipment. Fires can also degrade air quality when large burns are located nearby. Vehicle traffic in the area is limited primarily to daylight hours.

2.3.2 Vegetation

Historically, vegetation adjacent to the White River is believed to have consisted of a mixture of coniferous forest and patchy stands of deciduous trees of various ages. Alterations to this mosaic began in the late 1880's from land clearing and logging. Much of the present day floodplain is covered by mature stands of willow (*Salix sp.*), red alder (*Alnus rubra*) and cottonwood (*Populus trichocarpa*) interspersed with occasional young western red cedars (*Thuja plicata*). The understory along the White River consists of thick stands of blackberry (*Rubus discolor*). These species become established on new surfaces created by erosion or deposition of sediment during flood events. Forested wetlands are not uncommon along the edges of the White River.

2.3.3 Land Use

Land use in the action area is primarily rural and agricultural. The city of Buckley is located adjacent to the project area, and the city of Enumclaw is approximately two miles to the north. Residential and agricultural development within the action area is generally restricted to the bluffs above the White River, thus the relatively narrow floodplain associated with this reach is largely undeveloped.

2.3.4 Aquatic Resources

Anadromous fish species are present in the river at virtually all times of the year (Table 2-1). Anadromous fish trapped and transported at the Buckley fish trap include spring and fall Chinook (Onchorhynchus tshawytscha), coho salmon (O. kisutch), pink (O. gorbuscha) and steelhead (O. mykiss). According to the Washington Department of Fish and Wildlife, chum (O. keta) salmon are also present in the river. Juvenile salmon as well as post-spawn adult steelhead migrate downstream through the dam. Bull trout (Salvelinus confluentus) are caught in the Buckley trap each year but specific information on bull trout populations and habitat use in the White River drainage is limited. Resident species include whitefish, peamouth, sculpins, trout, shiners and suckers. Coho and spring Chinook salmon are of concern due to their decline in south Puget Sound drainages. Bull trout and Chinook salmon are both listed under the Endangered Species Act (ESA) within the White River basin. Puget Sound coho and steelhead are subjects of petitions for listing.

Table 2-1. Temporal Utilization of the Puyallup and White Rivers by Salmonids.

2.3.5 Terrestrial Resources

Wildlife inhabiting the project vicinity include black-tailed deer, Roosevelt elk, black bear, furbearers, raptors, owls, songbirds and other perching birds. Additionally, bald eagle (*Haliaeetus leucocephalus*), spotted owl (*Strix occidentalis*), and marbled murrelet (*Brachyramphus marmoratus*) may be found in the greater project area.

2.3.6 Threatened and Endangered Species

Animal species with ESA status in the project vicinity include bald eagle, spotted owl and marbled murrelet (all three are designated as threatened). Fish species with ESA protection at the project include Puget Sound bull trout and Chinook, both listed as threatened.

2.3.6.1 Bald Eagle: The bald eagle is currently listed as a threatened species under the federal ESA in the 48 contiguous states. The state of Washington also lists the bald eagle as a threatened species. The bald eagle is found only in North America and ranges over much of the continent, from the northern reaches of Alaska and Canada to northern Mexico. Recovery of the bald eagle has progressed to the point where this species is being considered for delisting. At least one bald eagle territory overlaps the project area. The nearest bald eagle nest is located adjacent to the existing diversion dam. There is suitable nesting, roosting and foraging habitat adjacent to the project area. Resident fish, anadromous salmon, and waterfowl most likely provide the bulk of foraging opportunities for bald eagles.

2.3.6.2 Northern Spotted Owl: The northern spotted owl was federally listed in July 1990 as threatened throughout its entire range in Washington, Oregon, and Northern California. The principal cause for the listing was the on-going loss of habitat resulting from the harvest of old-growth forest and conversion to young forest. There are no suitable nesting, roosting and foraging habitat within 5 miles of the project area.

2.3.6.3 Marbled Murrelet: The marbled murrelet was listed as threatened in Washington, Oregon, and California in 1991 under the federal ESA. A variety of factors were presented as contributing to its decline, including over-fishing (of its prey), entanglement in fishing nets, oil spills and loss of nesting habitat. The State of Washington also lists the marbled murrelet as threatened. Recent population estimates include 5,500 murrelets in Washington and a total population of about 300,000 birds in North America. Modeling for the Pacific Northwest population indicates an annual decline of 2 to 12 percent in the at-sea population of marbled murrelets. There are no suitable nesting, roosting and foraging habitat within 5 miles of the project area.

2.3.6.4 Bull Trout: Bull trout in the Coastal-Puget Sound distinct population segment (DPS) were listed as a threatened species by the USFWS on November 1, 1999. Dolly Varden were not listed as part of this action. However, both bull trout and Dolly Varden are present in the Coastal-Puget Sound DPS. Bull trout and Dolly Varden are very difficult to distinguish based upon physical features, and have similar life history traits and habitat requirements. Because these two species are closely related and have similar biological characteristics, the WDFW manages bull trout and Dolly Varden together as “native char”. Bull trout inhabit the White River all year, however, they are not thought to use the

project area except as a migration corridor. The project area is a high velocity mainstem reach with little rearing habitat and less than optimum river temperatures and characteristics. The project area is also lower in the system than typically used by bull trout. Some bull trout of the White River may exhibit an anadromous life history as each summer adult bull trout are caught in the fish trap and transported around the project area. Adult bull trout are thought to make spawning migrations into the headwaters of the White River system and into smaller colder streams. Adults may travel back down through the project area in late winter. Juvenile bull trout do pass through the project area probably in spring although exact timing is not known.

2.3.6.5 Chinook Salmon: Puget Sound Chinook salmon was listed as a threatened species on March 16, 1999. The ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Straits of Juan De Fuca, from the Elwha River eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington.

2.3.6.6 River Use: Detailed records show continued use of the White River by Chinook salmon. Generally considered a spring Chinook stock, Chinook of the project area return to the fish trap late each summer and into early fall. Adult fish are transported around the project area and generally swim upstream in search of suitable spawning habitat. On occasion, adult Chinook fall back downstream, through the project area and are recaptured at the fish trap. Suitable spawning habitat does exist in the gravel-dominated reaches upstream of the project area but spawning habitat becomes marginal in the canyon reaches below MMD. Juvenile Chinook salmon outmigrating from upstream spawning areas migrate past the project area in the early spring through early summer. Some limited rearing habitat exists upstream of the project site. Chinook are also produced at the White River Hatchery operated by the Muckleshoot Indian Tribe and located adjacent to the project area.

2.4 CULTURAL CONDITIONS

2.4.1 Cultural Resources

Section 106, as amended through 2004, of the National Historic Preservation Act of 1966, as amended through 2000 (NHPA) (16 USC 470), requires that Federal agencies identify and assess the effects of Federally assisted undertakings on historic properties and to consult with others to find acceptable ways to resolve adverse effects. Properties protected under Section 106 are those that are listed in or eligible for listing in the National Register of Historic Places (NRHP). Eligible properties must generally be at least 50 years old, possess integrity of physical characteristics, and meet at least one of four criteria for significance. Regulations implementing Section 106 (36 CFR Part 800) encourage maximum coordination with the environmental review process required by the National Environmental Policy Act (NEPA) and with other statutes. The Washington State Archaeological Sites and Resources Act (RCW 27.53) may also apply.

The USACE's proposed Area of Potential Effects (APE) was reviewed by the Washington State Office of Archaeology and Historic Preservation (OAHP) and they concurred with the USACE's definition of the APE for the project. The APE encompasses the barrier dam and both adjacent shores, the shoreline of the pool at its maximum elevation, the route of

the new setback levee on the north bank, a small sediment pond on the north bank, an area around the caretaker's house on the south bank where an access road may be constructed to reach the dam, all staging areas and access roads, the immediate headworks and its historic buildings and structures, including the intake works, stoney gates, tool shop, caretaker's house and associated garage and outbuildings, tramway, blacksmith shop, outbuildings, and relief operator's cottage, and associated view sheds. The barrier dam and adjacent associated facilities that constitute the headworks, were constructed in 1911.

To comply with Section 106 of the NHPA, a USACE archaeologist and an architectural historian conducted a cultural resources reconnaissance survey of the proposed project's APE. Cultural resources studies conducted for the project included: an examination of the archaeological and historic site records at the OAHP, a search of the OAHP electronic historic sites inventory database, other background and archival research, a pedestrian survey of the project area, two subsurface shovel tests, and an evaluation of the significance of the dam and associated structures and buildings. No properties listed in the National Register and no sites or structures listed in the state inventory were found to been previously recorded within the APE. The USACE sent letters to the Muckleshoot Tribe, the Puyallup Tribe, and the Yakima Nation soliciting any knowledge or concerns or religious significance for the APE.

The project area lies along the boundaries of the traditional territories of the Muckleshoot and Puyallup Tribes. The Muckleshoot Tribe's territory extended to the north and the Puyallup's to the south of the project area. The area to the north included the upper Green River valley and past researchers have placed that area within the territory of the Green River people or Skopamish (Benson and Moura 1985:13; Lewarch et al. 1996). During the historic-period these people came to be known as the Muckleshoot Indians. Swanton placed both the Muckleshoots and the Puyallups within the Nisqually dialectic group of the coastal division of the Salishan linguistic family (1952:428-429). The geographical position of the Skopamish required greater dependence on hunting and overland travel and the influence of the Yakima and Klickitat differentiated them from the neighboring Puget Sound groups (Lewarch et al. 1996:15-16). Swanton (1952:424-425), under Muckleshoot, lists the Skopamish as a subdivision living on the upper Green River, but does not mention any village sites. The Puyallup's occupied the mouth of the Puyallup River and the adjacent coast, including Car Inlet and the southern portion of Vashon Island.

The original Puyallup Reservation was established by the Medicine Creek Treaty of December 16, 1854. In January of 1857 the president approved Governor Steven's recommendation for the establishment of the Muckleshoot Indian Reservation on land that was formerly a military tract. In 1874 an executive order gave definite metes and bounds for the reservation, which by then contained 3,532.72 acres of land (Ruby and Brown 1992:141). People from several tribes lived on the Muckleshoot Indian Reservation, including some Nisqually, Cowlitzes, Muckleshoots, Steilacooms, and Indians of other tribes. Between 1890 and 1909 the Puyallups lost most of their original reservation land. Ruby and Brown, writing in 1992 (1992:169), reported that the Puyallup Tribe, Puyallup Reservation, Washington, owned 66.9 acres of land in several parcels.

An examination of the General Land Office (GLO) maps of 1873 and 1874 for the two townships in the project vicinity did not show any homesteads, but they did show a series of feeder branches connecting to the Naches Pass Road. One of the feeder branches is shown as a trail passing along the south side of the project area. The Naches Road itself is labeled and other branches are shown on the adjacent GLO to the north of the river. The King County History Link provided information that the trail over Naches Pass was originally used by Indians for hunting and to cross the Cascades between Puget Sound and

the Yakima Valley (2005). Settlers then began to cross the pass on foot and horseback and pushed for construction of a wagon road over the pass from Walla Walla to Steilacoom. In September or October of 1853 an emigrant wagon train of over 30 wagons succeeded in the first wagon train crossing of Naches Pass, reaching Fort Steilacoom on October 9, 1853 (King County HistoryLink 2005).

A pedestrian survey conducted by a USACE archaeologist on February 19, 2004 and two shovel tests on October 6, 2004 did not produce any evidence of Native American prehistoric or historic-period activity within the APE. A USACE architectural historian evaluated the dam and associated buildings and structures for their potential eligibility for nomination to the National Register. The White River Diversion dam headworks, crib dam, fish collection facility, and related dwellings and operations buildings represent one of the earliest diversion dams of it type in western Washington.

In accordance with Section 106 of the NHPA, the USACE has determined that the barrier dam and adjacent associated facilities that constitute the headworks of the White River Hydroelectric Project (WRHP) are eligible for the National Register as a contributing component (district) of the larger, discontiguous WRHP. The USACE has also determined that the proposed project will have an adverse effect on eligible properties by removal of the dam and the possible removal of a caretaker's house that is a contributing component of the headworks. The USACE has received SHPO concurrence with the APE and will submit for SHPO review and consideration a cultural resources report, an evaluation of the headworks and dam, and a Memorandum of Agreement (MOA) covering proposed mitigation measures. The proposed mitigation measures for removing the diversion dam, and possibly the caretaker's house, include: evaluation, documentation, supplemental Historic American Engineering Record (HAER) documentation in medium format photography as required, and SHPO approval of a report draft prior to demolition of the existing dam.

Citations:

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1992 A Guide to the Indian Tribes of the Pacific Northwest, Revised Edition. University of Oklahoma Press, Norman and London.

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2.5 PSE REFERENCE DESIGN

2.5.1 Description

The PSE reference design refers to a plan developed by PSE to replace the existing barrier structure and make improvements to diversion capability. The 1996 design (a 30–percent level design) was used to support PSE's FERC application to license and expand the hydroelectric facility. PSE is no longer pursuing the project. The design includes design plans, several technical memoranda, and a physical hydraulic model. This design is termed the "Reference Design" because the 7 preliminary alternatives investigated carry forward several features of this design and use the cost estimate developed by Natt McDougall Company as the cost basis for the 7 alternatives considered. The reference design optimizes conditions for the continued operation of the PSE diversion and includes several improvements to the PSE flume and intake. The design also includes modification to the fish trap, but does not include screening for the fish trap supply water to meet current fishery criteria. The facility will pass the maximum river flow without flooding the existing fish hatchery, located adjacent to the dam on the right bank. This design is depicted in Appendix F, Plate 1 titled "Reference Plan" and includes the following features:

- PSE continues to operate the diversion (up to 2,000 cfs) based on their existing water right.
- Existing trap-and-haul facility is maintained
- Fixed Crest Weirs: 108 lineal feet of fixed crest (6 weirs @ 18 lineal feet/ea)
- Inflatable Rubber Weirs: 132 lineal feet of rubber dam (2 @ 66 lineal feet/ea)
- Radial Gates: 51 lineal feet of radial gates (16-foot radial gate plus a 35-foot radial gate)
- Piers: 27 lineal feet
- Total Barrier Length: 318 lineal feet (abutment to abutment)

2.5.2 Cost

The capital cost for this design was estimated by the Natt McDougall Co. in a report titled "Constructability Review – White River Diversion Dam Rebuild, December 1996". The report presented a breakdown of cost in 1998 dollars. The total cost for the reference design in 2003 dollars is $8,132,147. Price escalation is based on 3 percent per year for 4 years. This estimate is used extensively as a basis for estimating costs for the original 7 alternatives presented in Section 3. An independent cost estimate has been developed for the refined designs designated as the Locally Preferred and Federally Preferred Alternatives.

SECTION 3 -- Plan Formulation

3.1 PROBLEMS AND OPPORTUNITIES

3.1.1 Existing and Future Without Project Conditions

In the 1960s, the FERC determined that it had jurisdiction over the White River Hydroelectric Project (FERC No. 2494), which includes the barrier structure. Following this decision, PSE, the current owner of the barrier structure and diversion intake, initiated work with FERC to obtain a license for the project. A draft license was issued by FERC in 1997. However, this license was appealed by PSE and federal and state resource agencies. Between 1997 and 2003, the Lake Tapps Task Force comprised of homeowners around Lake Tapps, PSE, Pierce County, resource agencies, and other local interests, worked collaboratively to resolve resource concerns associated with the FERC license and in general identify opportunities to preserve Lake Tapps. The USACE, although not an official member of the Task Force, participated in the process because of our critical dependence on the PSE barrier structure for fish passage. In November 2003, PSE, with the receipt of a second draft jeopardy Biological Opinion, determined for a number of reasons that it was no longer a viable option to continue to pursue a hydropower license and that they would cease operation of the project, including the diversion dam in January 2004. However, PSE has retained the right to initiate hydropower generation in the future, as well as making other beneficial uses of the reservoir. In order to meet its upstream fish passage obligations, the USACE entered into an interim operating agreement with PSE on December 23, 2003, under which PSE would continue to operate the barrier structure to ensure proper flows to the fish trap and the USACE would reimburse PSE for reasonable costs subject to funding availability.

Concurrent to these recent activities local interests are pursuing a potential regional water supply project, which would utilize the diversion intake, diverted flows, and other PSE owned facilities related to the hydropower project. One of the key initiatives of the Task Force was to obtain an additional water right for the proposed municipal water supply project. The additional water right, which was issued in June of 2003, is in addition to PSE's existing 2,000 cfs water right. The new water right is currently in litigation, however if successful, the new supply project could be operational in 20-25 years. PSE continues to hold their existing 2,000 cfs water right and is currently diverting flows to Lake Tapps to maintain water quality and recreational purposes of the lake. PSE's diversion to Lake Tapps to maintain water quality is expected to continue until the water supply project is approved and operational.

A principal responsibility of the USACE is to provide upstream passage of White River salmon around MMD. This responsibility is reliant upon a functioning barrier dam capable of being serviced and maintained in a safe manner and without undue physical and operational constraints. The existing barrier dam represents a source of operational uncertainty due to construction and operational requirements that fail to meet current safety and operational guidelines. The barrier dam contributes to fish injury from an exposed and uneven apron. Lack of sediment passage capability causes delay in fish transportation and additional burdens on MMD staff and its operational funds.

The existing condition assumes that the USACE continues to operate under the interim operating agreement with PSE to ensure our obligation to transport fish above MMD until an acceptable replacement facility is constructed. Despite the condition of the barrier structure and regardless of other interests in diverting water or not diverting water, the

USACE must ensure the barrier structure is functional and that adequate flows are provided to the fish trap. Existing limitations and liabilities of the barrier dam would remain or perhaps worsen during the period of the interim agreement. Fish passage at the USACE fish trap and MIT hatchery operations would continue but be susceptible to outages due to dam maintenance. Water withdrawals and instream flows would continue under existing conditions, though reliability of flume operations, given the existing barrier dam, would remain subject to unscheduled outages due to barrier dam failure. Adult transportation would be subject to continuing uncertainties and cost. Under the interim operating agreement with PSE, the USACE is expected to incur costs up to $920,000 per year. The present value of this amount over a 50-year period at the federal discount rate of %5.375 is $15.9 million dollars.

The following section outlines problems related to the existing structure, presents opportunities for resolving them, presents the criteria for developing design solutions, considers alternative plans and recommends the best solution to meet the federal objective of identifying the most cost-effective environmentally acceptable solution to provide and ensure long-term safe and efficient fish passage at Mud Mountain Dam.

3.1.2 Problems and Constraints.

3.1.2.1 Useful Life:The existing barrier structure, which serves as the barrier for the existing fish trap is past its useful life and in need of replacement. Minimal maintenance has been performed on the structure over the years. The replacement of sections following high water events can be unsafe and there are reported problems with injury for downstream migrating salmon. Repair of the current facility following high flow events often requires flow manipulation at MMD which has caused stranding and mortality for out-migrating fish.

3.1.2.2 Sediment Load: Heavy sediment load and bedload movement cause operational and maintenance challenges at the diversion and fish trap facility.

3.1.2.3 Maintain Fish Passage: Safe and efficient fish passage needs to be maintained around the MMD.

3.1.2.4 Wildlife: Activities should not adversely impact wildlife habitat and inhabitants.

3.1.2.5 Flooding and Seepage: Flooding and seepage needs to be controlled in the vicinity of the future fish trap.

3.1.2.6 Cost Sharing: Equitable cost sharing needs to be established amongst the project beneficiaries for any project betterments.

3.1.2.7 Water Rights: The existing diversion water right for 2,000 cfs cannot be impacted by the replacement project.

3.1.3 Opportunities

3.1.3.1 Upgrade Facility: Upgrade the existing dam to a robust structure which can safely pass downstream migrating salmon and that can be safely and efficiently maintained.

3.1.3.2 Pass Bedload: Provide features at a future trap that readily pass bedload and exclude or control sediment in the fishway and other hydraulic features of the trap.

3.1.3.3 Fish Attraction: Improve fish attraction at the trap entrance to compensate for potential false attraction by flow from the proposed gates.

3.1.3.4 Fish Barrier: Provide an effective barrier to the upstream migratory fish, which will also create hydraulic conditions to reliably supply the fish trap with water flowing by gravity.

3.1.3.5 Fish and Wildlife: Minimize environmental impacts to fish, other wildlife, and their habitat.

3.1.3.6 Flood Control: Implement levees and other means to control water during flood events.

3.1.3.7 Cost Share: Determine a fair allocation of cost participation by the Federal Government.

3.1.3.8 Alternatives: Consider all possible alternatives for trap-and-haul facilities, including alternate sites.

3.2 Planning Objectives and Plan Formulation Overview

3.2.1 Planning Objectives

3.2.1.1 Engineering: The following criteria relate to the completeness and effectiveness of any proposed solution.

(a) A fish barrier that effectively stops adult fish from migrating upstream.

(b) A barrier that yields adequate headwater level above the tailwater for the trap to operate under gravity flow conditions (if possible).

(c) A fish trap that effectively traps fish and can readily accommodate transporting future fish runs around the MMD.

(d) A fish trap water supply that has criteria screening and will yield sufficient flow through the trap as well as extra attraction water at the trap entrance

(e) A means to pass bedload to readily maintain an open fish trap water supply intake.

(f) A sediment control system that will minimize sediment accumulation in the fish trap.

(g) Adequate levees, dikes, or and armoring to control flood conditions at and around the facility.

3.2.1.2 Economic: The following criteria relate to the *efficiency* of any proposed solution.

(a) Based on Life Cycle Costs, identify the least cost environmentally acceptable solution to meet fish passage obligations.

3.2.1.3 Environmental: The following criteria relate to the acceptability of a proposed solution.

(a) Avoid or minimize adverse impacts to the aquatic environment.

(b) Minimize impacts to wildlife habitat around the facility.

(c) Provide features to minimize the impact to both upstream and downstream migrant fish.

(d) Comply with all applicable federal, state, and local environmental regulations.

3.2.2 Plan Formulation Overview

3.2.2.1 First Steps

The first step in the process considers various methods to pass upstream migrating fish above MMD. Due to the configuration of MMD where a fish ladder is not possible, a barrier type structure which allows for the collection of fish is the only viable option. Different barrier concepts and their applicability to the project are addressed below. The second step considers different locations that might provide additional spawning and rearing habitat between the existing barrier and MMD. Seven preliminary alternatives were considered at 3 different locations. These alternatives were developed to a 10% design level to compare and contrast the benefits and costs associated with different locations. The objective was to select a preferred location and plan that best met the engineering, economic and environmental planning criteria. These alternatives were considered without regard to current or future operation of the PSE diversion. It is recognized that the current diversion dam is a joint use facility. However, in an attempt to solely consider the objective of fish passage around the MMD, this stage of the design and cost development report does not consider project features that are required exclusively for the operation of the diversion. Additional details related to the preliminary alternatives can be found in Appendix F. A screening process of these alternatives resulted in the selection of a preferred plan which best met the federal objective and design criteria.

3.2.2.2 Final Steps

The final step in the plan formulation and evaluation process was to develop the preferred plan identified based on the 10% design evaluation to a 35% design level. This plan is referred to as the “Federally Preferred Alternative”. After the preliminary alternatives were evaluated, Pierce County sent a letter dated September 4, 2003 expressing willingness to serve as a non-Federal sponsor for a project that would not only meet the federal objective but also include betterments related to the diversion capability of the project. Such a project would be termed a “Locally Preferred Plan”. Pierce County is willing to work with the USACE toward an agreement on determining the local share of the project and to continue working on a “Locally Preferred Alternative” in a collaborative manner. The Locally Preferred Alternative is an improvement of the existing facility and provides features to optimize the diversion of flow from the river. The “Locally Preferred Alternative” is largely based on the PSE reference design developed by PSE in the 1990’s, however a fish screen for fishway water supply was included in addition to other modifications to the fish trap.

3.2.3 Plan Formulation Design Criteria

3.2.3.1 General: This section presents preliminary design criteria and constraints for evaluating alternative barrier dam and fish trap facilities for the Mud Mountain

Dam Fish Passage Project. Meetings were held with agency and tribal representatives to review, verify and modify criteria for the current evaluation process. The Seattle District USACE project team also reviewed and modified previous criteria. The criteria are used to guide the investigation, design and cost estimate development of the alternative sites considered for trapping and hauling adult migratory fish around the Mud Mountain Dam. The criteria list is a summary from previous studies prepared for upgrades to the existing PSE diversion, current design practice, project data, gaging station data, and other sources. The section presents biological, hydraulic, debris, sediment, and geologic, structural, and operational conditions.

3.2.4 Biological Criteria

3.2.4.1 Historical Trapped Anadromous Fish: 24% Chinook, 60% Coho, 15% Steelhead, and 1% other.

3.2.4.2 Fish Occurrence: See Figure 3-1, titled "Monthly Fish and Flow". This shows the monthly average counts of three species of fish, the minimum, maximum, and average of the monthly average flows, the 5% and 95% exceedance flows, and peak flood events.

3.2.4.3 Endangered Aquatic Species: Bull Trout and Puget Sound Chinook

3.2.4.4 Hatchery Spawned Fish: Spring Run Chinook. Hatchery steelhead seen at the Buckley trap are mostly from the Boights Creek hatchery on the Puyallup system.

3.2.4.5 Fish Velocity for barrier design

Measured in feet per second (Powers and Orsborne, 1985)

Species	Sustained	Prolonged	Burst
Steelhead	0-4.6	4.6-13.7	13.7-26.5
Chinook	0-3.4	3.4-10.8	10.8-22.4
Coho	0-3.4	3.4-10.6	10.6-21.5
Sockeye	0-3.2	3.2-10.2	10.2-20.6
Pink & Chum	0-2.6	2.6-7.7	7.7-15.0

Note: Velocities depend on optimal water temperature conditions and burst speeds are assumed sustainable for no more than 10-seconds. These values are used to determine fish exclusion effectiveness.

3.2.4.6 Vertical Barrier Requirements: 15 feet for plunge pool applications.

3.2.4.7 Average Fish Size

Species	Weight, lbs
Steelhead	12
Chinook	15
Coho	6
Pink	5
Bull Trout	2

3.2.4.8 Holding Capacity: Match Existing (250-adults up to 72 hours).

3.2.4.9 Holding Volume: 2.6 lbs per cubic foot

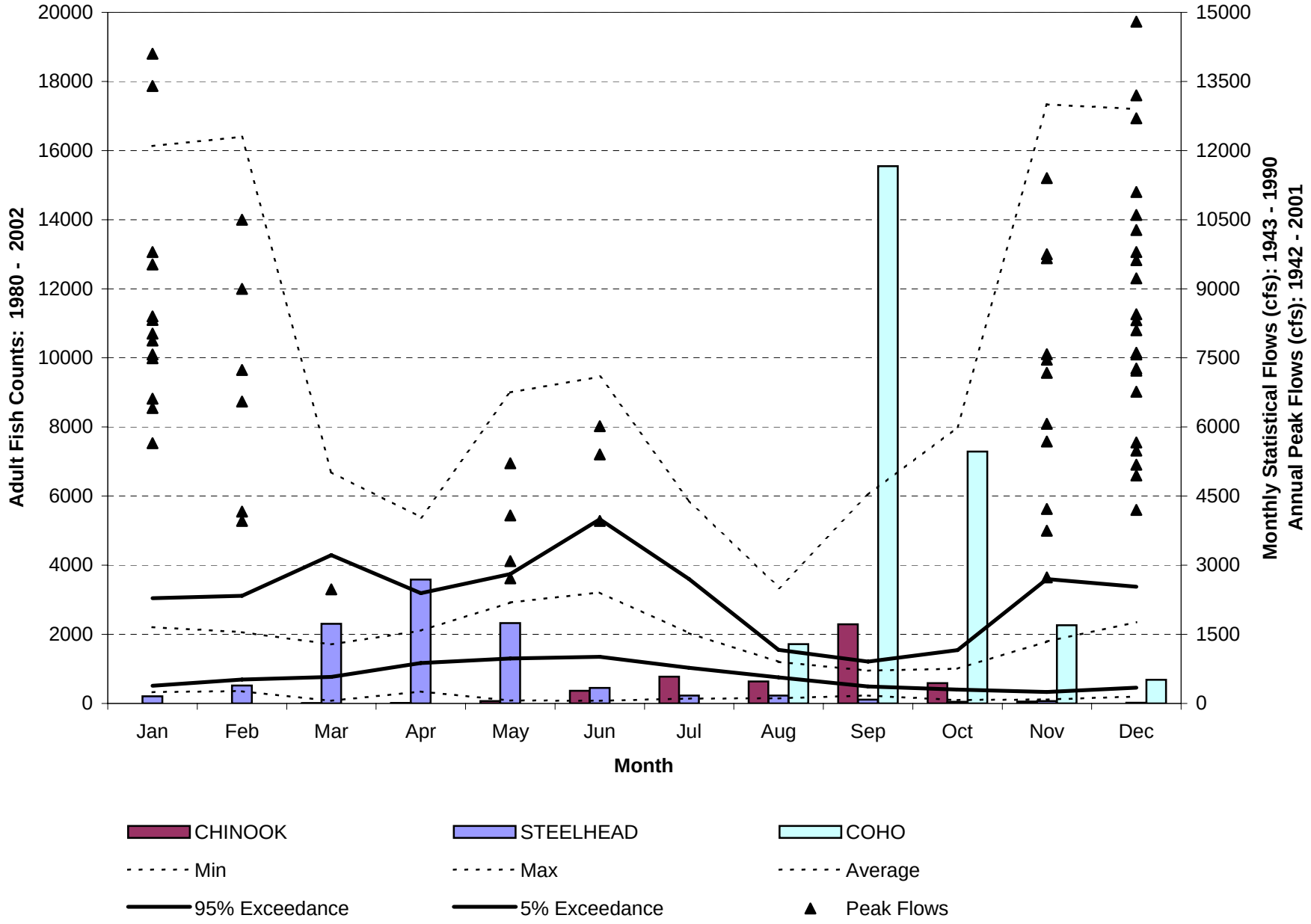


Figure 3-1 Monthly Fish and Flow

3.2.4.10 Holding Flowrate: 0.4-gpm per fish

3.2.4.11 Trap-and-Haul Objective:Release fish 5-miles upstream of MMD.

3.2.4.12 Trap-and-Haul Technique: Water to water transfer

3.2.4.13 Fish Attraction Flow Requirements: 1 to 1.5-foot drop across entrance

3.2.4.14 Fish Trap Supply Water Screens: The supply water will be screened to meet the National Marine Fishery Service criteria for salmonids. This criteria requires a 1.75-mm slot opening, 0.4 fps approach velocity, minimum 27-percent open area, and sweeping velocity greater than the approach velocity with a maximum exposure to the screen of 1 minute.

3.2.5 Hydraulic and Hydrologic Criteria

3.2.5.1 MMD Maximum Regulated Release: 24,800 cfs (Note, this flowrate has never been released and requires a full pool with both the 9-foot and 23-foot diameter tunnels fully open. Prior to the 1996 MMD intake improvements this rate was 17,600 cfs.)

3.2.5.2 MMD Flood Control: The USACE attempts to restrict releases to 12,000 cfs when feasible during operations to control downstream flooding (flow at Puyallup Gage exceeds, or is forecast to exceed, 45,000 cfs.)

3.2.5.3 Dam Structure Stability: Maximum Regulated Release - 24,800 cfs (Stability requires that the structure will remain in place without undermining from downstream scour, overturning from hydraulic loading, or damage to the structural integrity of the barrier including major gates and weirs.)

3.2.5.4 Access Road Stability: 100-year Recurrence - 12,000 cfs (road will remain intact with minimum of 2 feet of freeboard).

3.2.5.5 Equipment Protection: 100-year Recurrence - 12,000 cfs (electrical motors and other equipment vulnerable to submergence will have a minimum of 2 feet of freeboard).

3.2.5.6 Trap-and-Haul Operation: Criteria call for the facility to operate up the the 5% exceedance flow (3,400 cfs). The facility is designed to operate up to a flow of 4,000 cfs. Flows over 4,000 cfs will drown out the ladder. There will still be a head differential at the entrance. If fish are present, the facility can be operated at the operator's discretion.

3.2.5.7 Historical Exceedance Curves: See Figure 3-2, titled "White River Regulated Flow-Duration Curve Upstream of PSE Diversion (1943-1990)"

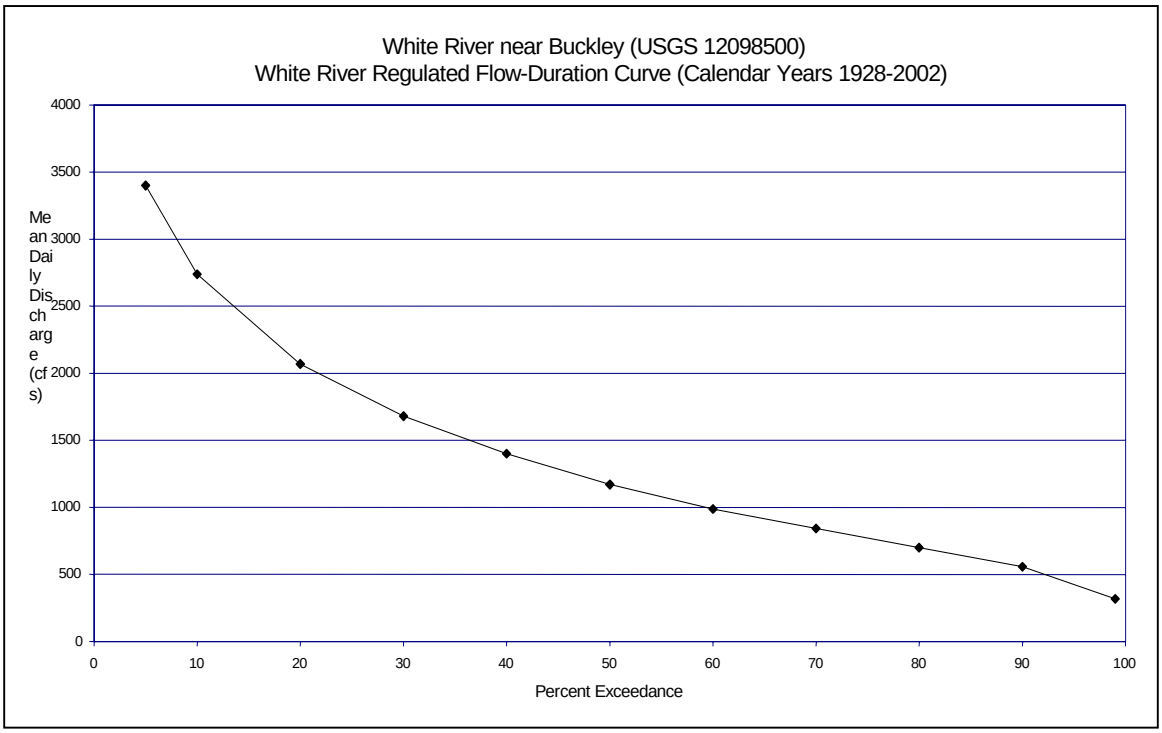


Figure 3-2 White River regulated Flow-Duration Curve

3.2.5.8 Facility Vehicular Access: The 5 percent Exceedance flow is 3,400 cfs. Vehicular access is maintained up to 4,000 cfs.

3.2.5.9 Historical Diversion Limits: Controlled Flashboard failure at 2 feet of differential above the flashboard crest. Steel gates pulled at 4,000 cfs which stops trap-and-haul operations.

3.2.5.10 Typical White River Flow: See Figure 3-1, titled "Monthly Fish and Flow"

3.2.5.11 PSE Diversion Tailwater Conditions: See Figure 3-3, titled "PSE Diversion Dam – Estimated Tailwater Stage-Discharge Plot (Rating Curve)"

3.2.5.12 Existing Fish Trap Flow: 25 – 35 cfs

3.2.5.13 PSE Diversion Water Right: 2,000 cfs

3.2.5.14 Muckleshoot Fish Hatchery Water Right (1988): 12 cfs

3.2.5.15 Minimum Instream Flow: Table 3-1 summarizes the current and proposed minimum instream flow requirements. This table was used during the PSE license application to define required and proposed flows. These rates are for informational purposes only, and are used to ensure that the proposed design will accommodate the range of flows presented and will be consistent with the minimum instream flow ultimately agreed to by the resource agencies.

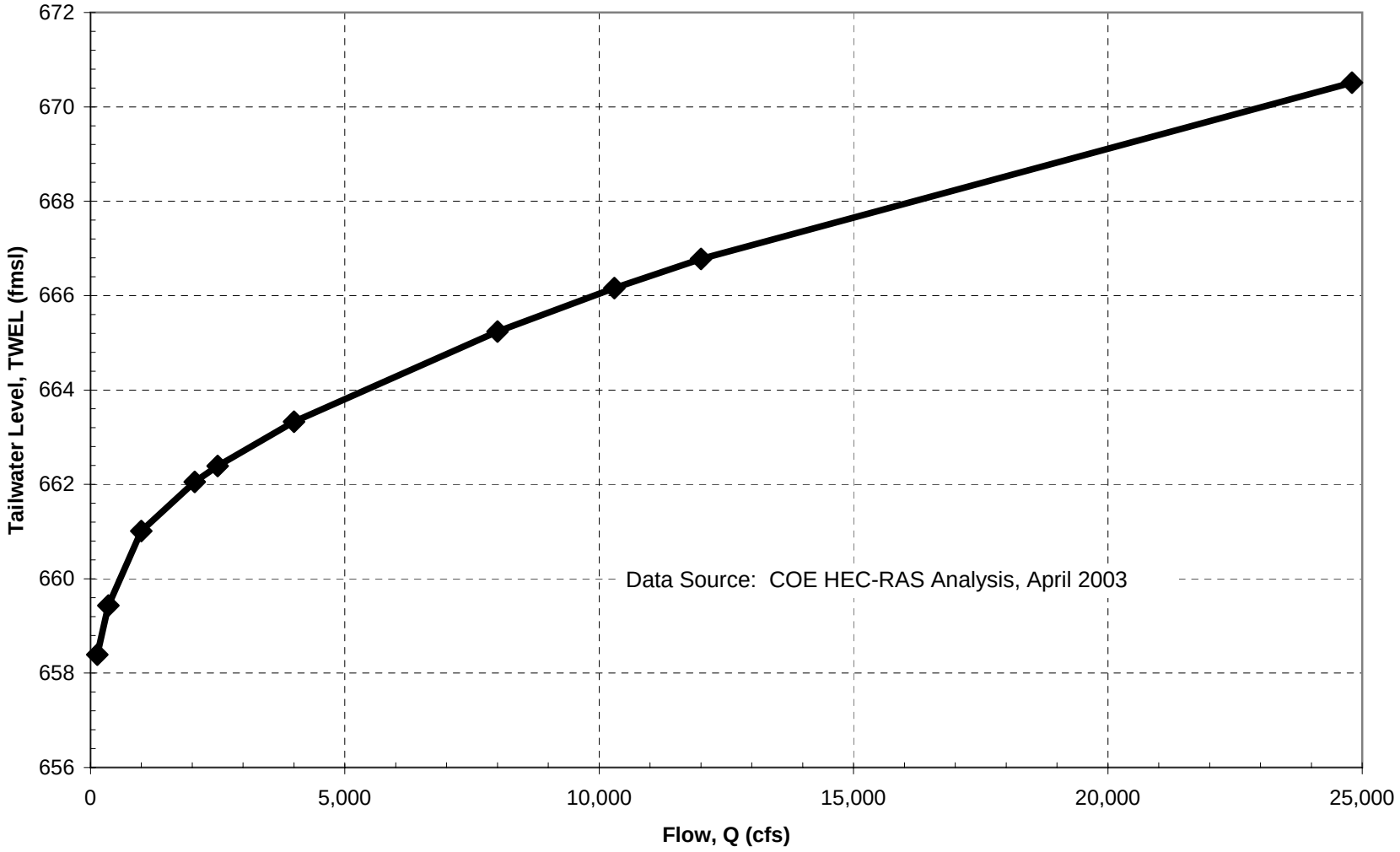


Figure 3-3 PSE Diversion Dam Estimated Tailwater Stage-Discharge Plot (Rating Curve)

Table 3-1 Minimum Instream Flow – Current Interim 10J

Month	Interim Flows July 2001 –Present at gage below. Boise Cr. (flows in cubic feet per second)
January	130
February	200
March	275
April	350
May	350
June	250
July	250
August	250
September	275*
October	250
November	130
December	130

* flows may be adjusted within the total volume of the month

The flows shown are the revised interim flows based on the end of the original 2-yr FERC stay, on an economic model, and refinement of flows to provide better summer flows and better revenue generation in late fall. These flows are also included in the USACE-PSE interim operating agreement.

3.2.5.16 Exclusion Apron Velocity: 24 fps at minimum length (velocity can be depreciated for longer apron lengths).

3.2.5.17 Exclusion Apron Minimum Length: 20 feet

3.2.5.18 Minimum Fishway Entrance Slot Width: 1.5 feet

3.2.5.19 Minimum Fishway Entrance Head: 1.0 foot

3.2.5.20 Maximum Fishway Entrance Head: 2.0 feet

3.2.5.21 Minimum Fishway Width: 8 feet

3.2.5.22 Minimum Fishway Depth: 5 feet

3.2.5.23 Minimum Fishway Orifice: 18 by 18 inches

3.2.6 Debris and Sediment Criteria

3.2.6.1 Maximum Debris Size: 12-inch diameter by 40-foot log

3.2.6.2 Typical Debris: sticks, leaves, branches, and ice

3.2.6.3 Debris Exclusion: Configure facility to minimize accumulations and promote flushing.

3.2.6.4 Sediment and bedload at the PSE Diversion: 100,000 to 1,000,000 tons/year (500,000 average)

3.2.6.5 Winter Flooding: 1000 – 2500-mg/l Suspended Solids

3.2.6.6 Bedload Movement: Flows in excess of 8,000 cfs result in gravel and cobble movement. Historically bedload in the range of 3.5 to 10 inches in diameter has accumulated at the PSE diversion.

3.2.7 Geologic Criteria

3.2.7.1 PSE Diversion Borings (40 to 50-feet-deep): Medium Dense to Dense Silty Sand Gravel with occasional Cobbles – No Bedrock encountered.

3.2.7.2 Seismic: Peak ground acceleration for a 475 year return is assumed equal to 0.36 g (this criteria needs further study to verify.)

3.2.7.3 Dam Classification: The barrier falls below Federal and State requirements for classification as a dam and is considered a "barrier".

3.2.7.4 Diversion Dam Site: Technical Memorandum No. 16 prepared by GeoEngineers on May 2, 1994, as a Final Geotechnical Report and recommendations for the diversion site.

3.2.7.5 Diversion Dam Site: Other geotechnical design criteria are presented in Appendix E – Design Considerations.

3.2.7.6 Gaging Station Conditions: Geophysical Investigation- White River Site Near Enumclaw, WA, August 2002, Shannon and Wilson, Inc.

3.2.8 Structural

3.2.8.1 Structural Criteria specific to the Diversion Dam Site: See Appendix E – Design Considerations.

3.2.8.2 Water unit Weight: 0.0625-k/cf

3.2.8.3 Concrete Unit Weight: 15-k/cf

3.2.8.4 Steel Unit Weight: 0.49-k/cf

3.2.8.5 Snow Load: 50-lb/sf

3.2.8.6 Walkway and Elevated Platform Live Load: 100-lb/sf – 300 lbs concentrated

3.2.8.7 Stairway Live Load: 100-lb/sf – 300 lbs concentrated

3.2.8.8 Handrail Live Load: 50-lb/sf – 200 lbs concentrated

3.2.8.9 Wind Load: 50-lb/sf

3.2.8.10 Ice Load:12-inch ice thickness @ 56/lbs/cf

3.2.8.11 Concrete Compressive Strength (Lean Concrete): 3000 psi

3.2.8.12 Reinforced Concrete Compressive Strength: 4000 psi

3.2.8.13 Reinforcing Steel: fy:60 ksi

3.2.8.14 General Steel: ASTM A36 (Fy=36 ksi) or ASTM A573 Gr 50 (Fy 50 ksi)

3.2.9 Operational Criteria

3.2.9.1 Existing Fish Trap: Unimpeded operation during flows in which fish are moving.

3.2.9.2 Trap Water Supply: Gravity flow

3.2.9.3 Muckleshoot Hatchery: Unimpeded operation

3.2.9.4 PSE Diversion: Unimpeded operation when river flow allows for diversion.

3.2.9.5 Fish Trap Access: Vehicular access up to a 100-year flood.

3.2.9.6 Bedload Flushing: Mechanical gate and concrete channeling.

3.2.9.7 Barrier Structure: Cast-in-place reinforced concrete.

3.2.9.8 Bedload: Minimize movement into diversions intake and fishway water supply intake.

3.2.9.9 Fish Transport Capacity: Allow no fish to be held for over 72 hours.

3.3 PRELIMINARY ALTERNATIVES

3.3.1 Introduction

The following paragraphs present other barrier concepts considered for this project. Next, the 7 preliminary alternatives are briefly described in terms of physical layout, operation, and cost at each of the three sites. The descriptions are followed by a comparison of the alternatives. This process concludes with a recommendation for the Federally Preferred Plan. The Federally Preferred Plan is refined and compared to the Locally Preferred Plan in Section 4.

3.3.2 Other Concepts and Features

3.3.2.1 General: The preliminary layouts presented in this report are primarily based on designs developed in association with the PSE diversion re-licensing effort. These layouts are used as a starting point for this investigation and will be further developed and modified in later investigations. Other features have been used successfully on other projects associated with trapping fish. Alternative fish barrier concepts are presented in this section with a discussion of how they apply to the project goals and criteria. Other features are also discussed such as alternative flow features and site access.

3.3.2.2 Other Barrier Concepts

(a) Fixed Picket Barriers: This barrier allows flow past a series of fixed pickets bolted to a concrete slab, while preventing fish from traveling upstream. The concept tends to be relatively inexpensive. The fixed pickets are susceptible to fouling by debris and bedload. Conditions in the White River are not conducive to its use. Flow is also difficult to manage, and fish attraction conditions to the trap entrance may be compromised.

(b) Floating Picket Barriers: This type of barrier is similar to a fixed picket barrier, however the pickets are hinged at the bottom and float in an inclined position in the downstream direction. The downstream end of the pickets extend up out of the water about 1.5 to 2 feet. This barrier is even more susceptible to debris and bedload fouling than the fixed pickets. It is not suitable for rivers with high debris loads and highly variable flows.

(c) Electronic Barriers: Alternating current and direct current barriers induce a varying current in the water *via* an array of electrodes placed across the river. As a fish approaches the array it becomes increasingly uncomfortable. Control of the electrodes is critical and varying water conductivity and fouling from sediment and bedload can be major obstacles for successful operation. Conditions in the White River are not conducive to its use. This alternative also has inherent electrical hazards to the public, which may not be appropriate for this project.

3.3.2.3 Other Gate and Access Options

(a) Hinged Crest Gates: This type of gate has the advantage of a rubber weir, while providing greater strength against bedload and debris. This type of gate could be considered in lieu of a rubber weir to lower operational risk.

(b) Roller Gates: This type of gate offers a less expensive mechanism than a tainter gate, but may not operate well in a high bedload stream. Water passes under this gate so bed load can accumulate on the seal plate and in the gate slots making it difficult to close. Because of bedload conditions this was not a preferred gate type.

(c) Gaging Station Site, Alternative Access: Access to the left bank of the gaging station site could be achieved by constructing a new road down from an existing road, southwest of the site. The existing road connects to the MMD crest. The new road could be used as either temporary construction access or permanent access. Permanent access would require a bridge across the river to the fish trap, as the site does not lend itself to a left bank fish trap. This road would be relatively steep, since the elevation change is from 820 fmsl at the site to approximately 1000 fmsl at the existing road.

3.3.3 Diversion Site (Alternatives 1, 2 and 3 – Appendix F)

3.3.3.1 General: The diversion site is the location of the existing trap-and-haul facilities utilized by the USACE for fish passage around the MMD. This site is the downstream-most site considered and the location of alternatives 1, 2, and 3. The site is about 6 miles downstream of the MMD, located near the eastern limits of the City of Buckley. The existing trap-and-haul facility is on the left bank of the river. It is located on the outside radius of a bend in the river (see Figure 1-1 titled “Fish Trap Sites”).

3.3.3.2 Alternative 1: Existing Left Bank (looking downstream) Trap-and-Haul with Ogee Weir and Radial Gate (see Plate 3, Appendix F). Much of the existing trap at the PSE diversion would be utilized and upgraded with addition of a screened auxiliary water intake to increase fish attraction water in the ladder to 130 cfs. This additional attraction flow will compensate for potential false attraction flow from the new gates. From the left bank to right bank, the dam would consist of a 16-foot radial gate and a 300-foot-long and 9-foot-high ogee weir. To protect the Muckleshoot Tribe's hatchery situated on the right bank a 2,250-foot-long levee would be built along that bank.

Total Capital Cost = $10,962,262
50-year Life Cycle O&M Cost = $2,281,464

3.3.3.3 Alternative 2: Existing Left Bank Trap-and-Haul with Rubber Weirs, Ogee Weir, Fixed-crest Panels, and Radial Gate (see Plate 4, Appendix F).The existing trap-and-haul facilities would be utilized and upgraded the same as in Alternative 1. The difference in this alternative is in the configuration of the dam. From left bank to right bank the dam would contain a 16-foot radial gate, a 73-foot-long ogee weir, two 73-foot-long rubber weirs, and a fixed crest panel section about 60-feet-long. Since the rubber weirs can be deflated during a flood event to allow water to pass, the flood water elevation in the pool behind the dam will not rise as high as in Alternative 1. Thus the levee can be lowered by five feet and shortened to 1,200 feet. Additional O&M costs over that of Alternative 1 are due to the operation costs of the rubber weirs and the periodic need for their replacement.

Total Capital Cost = $11,595,972
50-year Life Cycle O&M Cost = $3,116,118

3.3.3.4 Alternative 3: New Right Bank Trap-and-Haul with Rubber Weirs, Ogee Weir, Fixed-crest Panels, and Radial Gate (see Plate 5, Appendix F).This alternative is essentially the same as Alternative 2 except that it is the mirror image so that the trap-and-haul facility is now located on the right bank. This is considered as an alternative so that the fish entrances of this new trap-and-haul facility and the hatchery operated by the Muckleshoot Tribe located on the right bank can be consolidated. Thus the new trap-and-haul, ladder, and screened auxiliary water facilities would be located adjacent to the right abutment of the PSE barrier dam. The features of the trap would be the same size as those in Alternatives 1 and 2 but would have a different arrangement to conform to the topography and space limitations at the right abutment. Under this alternative from the left to right bank the barrier dam would consist of a fixed crest panel section about 60-feet-long, two 73-foot-long rubber weirs, a 73-foot-long ogee weir and a16-foot-wide radial gate. Since the operation during a flood would be the same is in Alternative 2 the protective levee on the right bank would be the same elevation and length as in Alternative 2. The slightly lower O&M cost from Alternative 2 are due to shorter fish haul distance.

Total Capital Cost = $12,306,461
50-year Life Cycle O&M Cost = $3,059,911

3.3.4 Gaging Station Site (Alternatives 4, 5 and 6 – Appendix F)

3.3.4.1 General: The Gaging Station site is situated at the end of a narrow canyon, approximately 1.5 miles downstream of the MMD. This is currently the site of the USGS gaging station No. 12098500. Locating alternatives 4, 5, and 6 for potential trap-and-haul facilities at this site would limit the barrier width to the relatively narrow mouth of the canyon and open up about 4.5 miles of river and some minor tributaries to adult salmon. A primitive access road currently extends to the right bank side of the site. Figure 1-1 titled "Fish Trap Sites" depicts the overall location of this site.

3.3.4.2 Alternative 4: Trap-and-Haul with Rubber Weirs, Ogee Weir and Radial Gate (see Plate 10, Appendix F) At the gaging station site the width of the river is much less than at the PSE diversion. The ladder and fish trap would be located on the right bank in the flat area at the mouth of the canyon. They would have the same types and size of features as provided in the other alternatives. The barrier dam would be located just inside the canyon. From the right bank to the left bank, the dam would consist of a 16-foot radial gate, a 20-foot-wide ogee weir, and two 48-foot-wide by 9.5-foot-high rubber weirs. In addition, access improvements would be made on the right bank for permanent access and possibly on the left bank for temporary construction access.

Total Capital Cost = $10,256,086
50-year Life Cycle O&M Cost = $2,752,320

3.3.4.3 Alternative 5: Trap-and-Haul with Ogee Weir and Two Radial Gates (see Plate 11, Appendix F) The ladder, trap, and auxiliary water arrangement is the same as in Alternative 4. The dam consists of two radial gates, a 16-foot-wide gate located at the right abutment and a 35-foot-wide radial gate located adjacent to the left of the 16-foot gate. An 87-foot-long ogee weir extends from the 35-foot gate to the left abutment. The access improvements are the same as for Alternative 4. Lower O&M cost of this alternative over Alternative 4 are due largely to the lower maintenance and periodic replacement costs of the 35-foot radial gate over the rubber dam.

Total Capital Cost = $8,898,617
50-year Life Cycle O&M Cost = $2,477,116

3.3.4.4 Alternative 6: Trap-and-Haul with Ogee Weir and Radial Gate (see Plate 12, Appendix F) This alternative has all the same features as Alternative 5 except the dam. From the right to left bank the dam consists of a 16-foot-wide radial gate and a 127-foot-wide ogee weir. The access improvements are the same as for Alternatives 4 and 5. O&M cost of this alternative is the lowest because the periodic replacement cost of both the Rubber Dam and the 35-foot radial gate are avoided. However, the ability and reliability of passing bedload and sediment is reduced.

Total Capital Cost = $8,219,604
50-year Life Cycle O&M Cost = $2,168,792

3.3.5 MMD Site (Alternative 7 – Appendix F)

3.3.5.1 General: The MMD site is located at the base of the MMD. This site is within the project limits and adjacent to the outlet of the 9-foot-diameter tunnel for bypassing flow beneath the dam. Access to the site is achieved by a steep road with multiple switch-backs down the face of the dam. This location opens up an additional 1. 5 miles of river beyond the gaging station site, but is subject to very high velocities from flow exiting the tunnels. Figure 1-1 titled "Fish Trap Sites" shows the overall location of this site.

3.3.5.2 Alternative 7A: Mud Mountain Dam Site - without Fish Gondola (see Plate 17, Appendix F) The advantage of this site is that since MMD is the barrier there is no need to build a new barrier dam. However the barrier dam in Alternatives 1 through 6 provided water for fish ladder operation that is not available in this alternative. Thus the ladder and trap water supplies must be pumped from the river. The fish ladder, trap and auxiliary water screen would have the same features and size as for the other alternatives. The 9-foot-diameter tunnel would discharge next to the ladder entrance and likely result in false attraction from the trap. A new bridge would extend from the trap to the 23-foot-diameter tunnel, and improvements to the access road down the face of the dam would be constructed.

Total Capital Cost = $6,704,141
50-year Life Cycle O&M Cost = $2,644,826

3.3.5.3 Alternative 7B: Mud Mountain Dam Site - with Gondola (see Plate 17, Appendix F) The same as Alternative 7A except that a fish gondola feature is added so that the tanker trucks used to haul the trapped fish would not have to travel down the dam face. Instead, the fish hopper would be transported from the trap to the dam crest for transfer to the tanker truck shortening and simplifying the haul considerably. Additional capital and O&M costs over Alternative 7A are due to the gondola.

Total Capital Cost = $8,167,901
50-year Life Cycle O&M Cost = $3,033,005

3.4 SCREENING OF ALTERNATIVES FOR FEDERALLY PREFERRED PLAN

3.4.1 Comparison Matrices

The comparison of the seven alternatives is presented in two tables: Table 3-2, titled "Alternatives Comparison Matrix" and Table 3-3, titled "Biological Considerations". These matrices present the descriptions of the alternatives as they relate to important aspects of designing, constructing, and operating an effective and efficient trap-and-haul facility within the criteria established. The numbering scheme associated with these matrices ranks the various attributes as: Good (1), Medium (2), and Poor (3).

3.4.1.1 Cost

(a) Basis: Costs are presented in terms of 2003 dollars. The federal discount rate for water resource projects of %5.875 for fiscal year 2003 was used to annualize project costs. Major mechanical

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Mechanical Reliability	1 Minimal Mechanical Features	2 Moderate level of mechanical features.	2 Moderate level of mechanical features.	2 Moderate level of mechanical features.	2 Moderate level of mechanical features.	1 Minimal Mechanical Features	3 Requires continuous pumping	3 Requires continuous pumping and a gondola for reliable fish transport
Power Reliability	1 Relatively close to City grid with minor exposure to trees	1 Relatively close to City grid with minor exposure to trees	1 Relatively close to City grid with minor exposure to trees	3 Isolated from power grid with high exposure to trees	3 Isolated from power grid with high exposure to trees	3 Isolated from power grid with high exposure to trees	3 Relatively close to MMD source with minor exposure to trees, but requires continuous supply for pump.	3 Relatively close to MMD source with minor exposure to trees, but requires power for gondola and continuous supply for pump.
Trap & Haul Reliability	1 Close to relatively flat paved roads and Fish Hatchery	1 Close to relatively flat paved roads and Fish Hatchery	1 Close to relatively flat paved roads and at Fish Hatchery	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	3 Most susceptible to failure.	3 Most susceptible to failure, but with improved access due to gondola
Flooding	3 Results in relatively high headwater during floods requiring substantial levee improvements	2 Results in moderate headwater during floods and requires levee improvements	2 Results in moderate headwater during floods and requires levee improvements	2 Results in moderate headwater during floods and creates a 1500 to 2500' long pool up the canyon	2 Results in moderate headwater during floods and creates a 1500 to 2700' long pool up the canyon	2 Results in moderate headwater during floods and creates a 1500 to 3000' long pool up the canyon	1 Does not impede the river flow and is relatively immune to flooding.	
Protection from Vandalism	2 Within public view for reasonable monitoring.	2 Within public view for reasonable monitoring, but with extensive vulnerable features.	2 Within public view for reasonable monitoring, but with extensive vulnerable features.	3 Isolated and difficult to monitor with extensive vulnerable features.	3 Isolated and difficult to monitor.	3 Isolated and difficult to monitor.	1 Isolated, but within secured project site.	

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Access Reliability	1 Topography is relatively flat with access from both sides	1 Topography is relatively flat with access from both sides	1 Topography is relatively flat with access from both sides	2 Topography is relatively flat, but road is vulnerable to downed trees, and erosion by the river.	2 Topography is relatively flat, but road is vulnerable to downed trees, and erosion by the river.	2 Topography is relatively flat, but road is vulnerable to downed trees, and erosion by the river.	3 Access road is very steep (16% average) and likely will be impassable during bad weather (ice/snow)	2 Relies on gondola operation during bad weather (ice/snow). Personnel access to the site is still difficult.
Ease of Trap and Haul Operation	1 Good truck access and layout	1 Good truck access and layout	1 Good truck access and layout, next to Hatchery for improved fish sorting, New Trap	1 Good truck access and layout, New Trap	1 Good truck access and layout, New Trap	1 Good truck access and layout, New Trap	3 Restricted Site	3 Restricted Site and gondola will likely require two people for operation
Trapping Efficiency	1 Least variable tailwater and hydraulics moderately favorable	1 Least variable tailwater and hydraulics moderately favorable	1 Least variable tailwater and hydraulics moderately favorable	1 Moderately variable tailwater and favorable hydraulic conditions	1 Moderately variable tailwater and favorable hydraulic conditions	1 Moderately variable tailwater and favorable hydraulic conditions	3 Most variable tailwater and increasingly unfavorable hydraulic conditions at higher flow (greater than 1500-cfs)	
Sedimentation in Fish Trap	1 Shortest fish ladder requires least amount of sediment control	1 Shortest fish ladder requires least amount of sediment control	3 Right bank location will likely lead to greater sediment problems.	2 Moderately long fish ladder results in extra sediment control	2 Moderately long fish ladder results in extra sediment control	2 Moderately long fish ladder results in extra sediment control	3 Relatively long fish ladder, and pump station result in greater area to control sediment.	
Hatchery Operational Coordination	1 Relatively short distance to transport sorted hatchery fish.	1 Relatively short distance to transport sorted hatchery fish.	1 Sorted hatchery fish are onsite requiring minimal handling.	2 Moderately long distance to transport sorted hatchery fish.	2 Moderately long distance to transport sorted hatchery fish.	2 Moderately long distance to transport sorted hatchery fish.	3 Relatively long way to transport sorted hatchery fish	

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Debris, bedload, and Ice Handling	2 Least mechanical features in the flowline and screens remain submerged. 16' Radial gate may not be adequate for passing bedload.	2 Rubber weirs may be vulnerable to large bed load, but fish screens remain submerged.	3 Right bank siting is counter to the natural flow of the river and re-training may be needed. Rubber weirs may be vulnerable to large bed load, but fish screens remain submerged.	3 Debris will tend to be concentrated in the narrow channel. Rubber weirs may be vulnerable to large bed load, but fish screens remain submerged.	1 Debris will tend to be concentrated in the narrow channel. Moderate mechanical features in the flowline, 35' Radial gate provides extra bedload moving capacity.	2 Debris will tend to be concentrated in the narrow channel. Least mechanical features in the flowline and screens remain submerged. 16' Radial gate may not be adequate for passing bedload.	2 Relatively free from debris with possible large bedload buildup near intake screen but fish screens remain submerged	
Energy Efficiency	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	1 Relatively efficient operation due to small electrical loads on frequently operating equipment.	3 Inefficient because of continuous pumping	
Constructability	1 Left and right bank access with a broad river bed improves constructablity	1 Left and right bank access with a broad river bed improves constructablity	1 Left and right bank access with a broad river bed improves constructablity	2 Site is limited to right bank access with possible, but likely expensive left bank access. Relatively narrow and steep river bed results in more challenging water control, but surface bedrock may reduce dewatering.	2 Site is limited to right bank access with possible, but likely expensive left bank access. Relatively narrow and steep river bed results in more challenging water control, but surface bedrock may reduce dewatering.	2 Site is limited to right bank access with possible, but likely expensive left bank access. Relatively narrow and steep river bed results in more challenging water control, but surface bedrock may reduce dewatering.	3 Site has steep access and is restricted in size.	

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Design Issues	1 Significant studies, modeling, and survey have already been performed. Existing fish passage performance is relatively well understood.	1 Significant studies, modeling, and survey have already been performed. Existing fish passage performance is relatively well understood.	2 Significant studies, modeling, and survey have already been performed. Fish passage performance with the proposed configuration has unresolved issues.	2 Additional studies, modeling, and survey are needed. Fish passage performance would need particular study.	2 Additional studies, modeling, and survey are needed. Fish passage performance would need particular study.	2 Additional studies, modeling, and survey are needed. Fish passage performance would need particular study.	3 Significant study, modeling, and survey is needed. Fish passage performance would likely need physical hydraulic modeling just to determine feasibility.	3 Significant study, modeling, and survey is needed. Fish passage performance would likely need physical hydraulic modeling just to determine feasibility.
O &M Annual Labor, Equip., & Material $/yr (2003 Dollars)	$134,560	$160,460	$160,460	$146,520	$145,050	$131,040	$120,900	$141,420
O & M Annual Power Cost (2003 Dollars)	$1,555	$1,621	$1,621	$1,599	$1,774	$1,555	$29,872	$30,047
O & M Equip. Replacement Cost per event (2003 Dollars)	$174,420	$918,346	$818,346	$669,560	$216,886	$74,420	$402,600	$502,600
Present Value O&M Costs over 50 years (2003 Dollars)	**$2,281,000**	**$3,116,000**	**$3,060,000**	**$2,752,000**	**$2,477,000**	**$2,169,000**	**$2,645,000**	**$3,033,000**

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
CONSTRUCTION COSTS (2003 Dollars)	**$6,746,000**	**$7,136,000**	**$7,573,000**	**$6,069,000**	**$5,476,000**	**$5,058,000**	**$3,972,000**	**$4,873,000**
CONTINGENCY (30% OF CONST.) (2003 Dollars)	**$2,024,000**	**$2,141,000**	**$2,272,000**	**$1,821,000**	**$1,643,000**	**$1,517,000**	**$1,192,000**	**$1,462,000**
PLANNING & DESIGN (15% OF CONST. + CONT.) (2003 Dollars)	**$1,316,000**	**$1,392,000**	**$1,477,000**	**$1,183,000**	**$1,068,000**	**$986,000**	**$1,024,000**	**$1,200,000**
ENVIRONMENTAL (10% OF CONST. + CONT.) (2003 Dollars)	**$877,000**	**$928,000**	**$985,000**	**$1,183,000**	**$712,000**	**$658,000**	**$516,000**	**$633,000**
TOTAL PROJECT CAPITAL COST (2003 Dollars)	**$10,963,000**	**$11,597,000**	**$12,307,000**	**$10,256,000**	**$8,899,000**	**$8,219,000**	**$6,704,000**	**$8,168,000**
PSE Site Fish Passage Cost Range (2003 Dollars) Costs excluded from Total Life Cycle Cost	Upstream fish passage not needed.	Upstream fish passage not needed.	Upstream fish passage not needed.	Requires PSE Dam Removal, Simple Fish Ladder, or Extensive Ladder: Cost Estimate: $1,000,000	Requires PSE Dam Removal, Simple Fish Ladder, or Extensive Ladder: Cost Estimate: $1,000,000	Requires PSE Dam Removal, Simple Fish Ladder, or Extensive Ladder: Cost Estimate: $1,000,000	Requires PSE Dam Removal, Simple Fish Ladder, or Extensive Ladder: Cost Estimate: $1,000,000	Requires PSE Dam Removal, Simple Fish Ladder, or Extensive Ladder: Cost Estimate: $1,000,000
Real Estate and Property Issues	Possible Area (acres) requiring easements or acquisition: Access Road: 2.0 Site: 4.1 Dike 3.0 Total: 9.1	Possible Area (acres) requiring easements or acquisition: Access Road: 2.0 Site: 4.1 Dike 1.7 Total: 7.8	Possible Area (acres) requiring easements or acquisition: Access Road: 2.0 Site: 5.2 Dike 1.7 Total: 7.8	Possible Area (acres) requiring easements or acquisition: Access Road: 1.6 Site: 3.1 Total: 4.7	Possible Area (acres) requiring easements or acquisition: Access Road: 1.6 Site: 3.1 Total: 4.7	Possible Area (acres) requiring easements or acquisition: Access Road: 1.6 Site: 3.1 Total: 4.7	1 Site is within the MMD Project	

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-2
Alternatives Comparison Matrix

Criteria	**Alternative 1** Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	**Alternative 2** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	**Alternative 3** Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	**Alternative 4** Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 5** 16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	**Alternative 6** 16' Radial Gate, Ogee Crest, Trap and Haul Facility	**Alternative 7A** Trap and Haul Facility with Pump Station and Bridge Replacement	**Alternative 7B** Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
TOTAL 50-YEAR LIFE CYCLE COSTS (2003 Dollars)	**$13,244,000**	**$14,713,000**	**$15,367,000**	**$13,008,000**	**$11,376,000**	**$10,388,000**	**$9,349,000**	**$11,201,000**

This table is used to screen for the Federally Preferred Alternative selection. The cost estimating assumptions are consistent among alternatives. However, please note that further analysis of the Federally Preferred and Locally Preferred alternatives discussed in Section 4 use different cost estimating assumptions than those reported in this table.

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-3
Biological Considerations

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7A	Alternative 7B
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Alternative Description	Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	16' Radial Gate, Ogee Crest, Trap and Haul Facility	Trap and Haul Facility with Pump Station and Bridge Replacement	Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Mainstem Spawning	2 Mainstem Spawning Habitat Available including most suitable areas. Mainstem habitat is not limiting.	2 Mainstem Spawning Habitat Available including most suitable areas. Mainstem habitat is not limiting.	2 Mainstem Spawning Habitat Available including most suitable areas. Mainstem habitat is not limiting.	1 Most Mainstem Habitat available including all suitable mainstem reaches.	1 Most Mainstem Habitat available including all suitable mainstem reaches.	1 Most Mainstem Habitat available including all suitable mainstem reaches.	1 All Mainstem Habitat Available but little additional from Canyon Reaches	1 All Mainstem Habitat Available but little additional from Canyon Reaches
Tributary Spawning	1 Tributary spawning habitat is available including most suitable areas. Red Creek unaccessable but offers little spawning habitat.	1 Tributary spawning habitat is available including most suitable areas. Red Creek unaccessable but offers little spawning habitat.	1 Tributary spawning habitat is available including most suitable areas. Red Creek unaccessable but offers little spawning habitat.	1 All tributary habitat is available including Red Creek.	1 All tributary habitat is available including Red Creek.	1 All tributary habitat is available including Red Creek.	1 All tributary spawning habitat is available including Red Creek.	1 All tributary spawning habitat is available including Red Creek.
Mainstem Juvenile Rearing	2 All mainstem juvenile rearing habitat is available for downstream migrants. Habitat between diversion dam and MMD is unacessable.	2 All mainstem juvenile rearing habitat is available for downstream migrants. Habitat between diversion dam and MMD is unacessable.	2 All mainstem juvenile rearing habitat is available for downstream migrants. Habitat between diversion dam and MMD is unacessable.	1 All mainstem juvenile rearing habitat is available for downstream and upstream migrants. Rearing habitat within the canyon is limited.	1 All mainstem juvenile rearing habitat is available for downstream and upstream migrants. Rearing habitat within the canyon is limited.	1 All mainstem juvenile rearing habitat is available for downstream and upstream migrants. Rearing habitat within the canyon is limited.	1 All mainstem juvenile rearing habitat is available for downstream and upstream migrants. Rearing habitat within the canyon is limited.	1 All mainstem juvenile rearing habitat is available for downstream and upstream migrants. Rearing habitat within the canyon is limited.

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-3
Biological Considerations

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7A	Alternative 7B
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Alternative Description	Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	16' Radial Gate, Ogee Crest, Trap and Haul Facility	Trap and Haul Facility with Pump Station and Bridge Replacement	Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Tributary Juvenile Rearing	3 Results in relativey high headwater during floods requiring substaintial levee improvements	2 Results in moderate headwater during floods and requires levee improvements	2 Results in moderate headwater during floods and requires levee improvements	2 Results in moderate headwater during floods and creates a 1500 to 2500' long pool up the canyon	2 Results in moderate headwater during floods and creates a 1500 to 2500' long pool up the canyon	2 Results in moderate headwater during floods and creates a 1500 to 2500' long pool up the canyon	1 Does not alter river flow and is protected from flooding.	
Flow	1 Good approach characteristics and consistancy of flow at the site.	1 Good approach characteristics and consistancy of flow at the site.	1 Good approach characteristics and consistancy of flow at the site.	2 Moderate to Poor approach characteristics and consistancy of flow at the site.	2 Moderate to Poor approach characteristics and consistancy of flow at the site.	2 Moderate to Poor approach characteristics and consistancy of flow at the site.	3 Poor approach characteristics. Highly turbulant and inconsistant flow.	
Water Quality	2 Some potential for upstream water quality degradation from agriculture and suburban growth.	2 Some potential for upstream water quality degradation from agriculture and suburban growth.	2 Some potential for upstream water quality degradation from agriculture and suburban growth.	1 Location is above most potential human caused water quality issues.	1 Location is above most potential human caused water quality issues.	1 Location is above most potential human caused water quality issues.	1 Location is above most potential human caused water quality issues.	1 Location is above most potential human caused water quality issues.

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-3
Biological Considerations

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7A	Alternative 7B
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Alternative Description	Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	16' Radial Gate, Ogee Crest, Trap and Haul Facility	Trap and Haul Facility with Pump Station and Bridge Replacement	Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Passage Reliability	1 Close to relatively flat paved roads and Fish Hatchery	1 Close to relatively flat paved roads and Fish Hatchery	1 Close to relatively flat paved roads and at Fish Hatchery	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	2 Moderately distance from the Fish Hatchery, but could be prone to access problems	3 Most susceptible to failure.	3 Most susceptible to failure, but with improved access due to gondola
Ease of Support to Fish Manage	1 Supports adjacent hatchery operations and adequate room for research or tagging needs.	1 Supports adjacent hatchery operations and adequate room for research or tagging needs.	1 Supports adjacent hatchery operations and adequate room for research or tagging needs.	2 No support to hatchery. Some room available for research or tagging needs.	2 No support to hatchery. Some room available for research or tagging needs.	2 No support to hatchery. Some room available for research or tagging needs.	3 No support for hatchery and little additional room for research or tagging needs.	
Resident Fish Population	1 Provides resident fish with good habitat with limited competition.	1 Provides resident fish with good habitat with limited competition.	1 Provides resident fish with good habitat with limited competition.	2 Provides resident fish with some habitat with limited competition.	2 Provides resident fish with some habitat with limited competition.	2 Provides resident fish with some habitat with limited competition.	3 Provides full habitat integration between resident and anadromous fish.	

Legend:
1 - Good
2 - Medium
3 - Poor

Table 3-3
Biological Considerations

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7A	Alternative 7B
Location	PSE Diversion Dam Site (east side of Buckley)			Gaging Station Site (Canyon Outlet)			Mud Mountain Dam (base of dam)	
Alternative Description	Fixed Ogee Crest Spillway, 16' Radial Gate Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest Existing Left Bank Trap and Haul Facility (modified)	Two Rubber Dams, Fixed Crest (Panels), 16' Radial Gate, Ogee Crest New Right Bank Trap and Haul Facility (modified)	Two Rubber Dams, 16' Radial Gate, Ogee Crest, Trap and Haul Facility	16' and 35' Radial Gates, Ogee Crest, Trap and Haul Facility	16' Radial Gate, Ogee Crest, Trap and Haul Facility	Trap and Haul Facility with Pump Station and Bridge Replacement	Trap and Haul Facility with Pump Station, Bridge Replacement, and Fish Transport Gondola
Wildlife	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated	1 No significant disruption to existing wildlife anticipated.	

Legend:
1 - Good
2 - Medium
3 - Poor

equipment such as gates, rubber dams, and pumps, are assumed replaced twice during the 50-year interval. Power costs are based on $0.06/kWH. Real estate costs are not included in the capital or life cycle costs however the estimated project footprint is included in the matricies.

(b) Fish Ladder: Costs for a fish ladder are included for the sites upstream of diversion to allow for adult upstream migrant fish to pass the diversion. These costs are shown as a separate line item and are not included in the total capital costs.

3.4.2 Comparison Summary

3.4.2.1 General: The summary of these comparisons is presented by site and alternative. The summaries of each alternative are made in the context of: reliability, feasibility, biological concerns, design uncertainty, and cost.

3.4.2.2 Diversion Site

(a) General: This site ranks the highest among the various sites due to the proximity to utilities and well established roads. Power and access is also less prone to outage by downed trees or land slides. The trap-and-haul route has relatively close access to Highway 410.

The diversion site is a proven location. This site has been studied much more extensively than the other sites and the configuration can be refined rather than starting new. This site is closest to the fish hatchery, which makes the transfer of spring Chinook the most efficient. Improvements will provide enhanced flow at the hatchery fishway entrance. Hydraulic and geologic conditions are best known at this site. The site has ready access from both sides of the river.

The diversion site has provided effective fish passage for the past 61 years and has proven itself capable of sustaining proper flow, substrate and water quality conditions for fish passage. The primary reason for considering other sites further upstream are to open up potential spawning habitat. The diversion site currently prohibits adult salmonid access to approximately 5 miles of mainstem that probably contains some degree of spawning habitat. Chinook and coho have been recorded utilizing the diversion reach for spawning by falling back through MMD.

(b) Alternative 1: This alternative is the least costly alternative at this site, both in terms of capital costs and operational and maintenance costs. The total life cycle cost is estimated at $13,244,000. The alternative would be more reliable from the standpoint of mechanical failure, by having fewer mechanical features. However, the ability to pass bedload is not as effective as Alternatives 2 or 3. This may make maintenance more difficult. However bedload passage concerns under this alternative when compared to alternative 6 at the gaging station site are lower because of the flows and bedload diverted to Lake Tapps. A second radial gate would resolve any potential bedload passage concerns while still presenting an option much

simplier than alternative 2 or 3. This alternative results in the highest headwater conditions during high river flow.

(c) Alternative 2: This alternative is the second least costly at this site. The total life cycle cost is estimated at $14,712,000. It can pass bedload the most effectively of the alternatives by having multiple sections or panels located within the main channel of the river yet reliability is somewhat reduced with rubber weirs.

(d) Alternative 3: This alternative is the most expensive at this site, requiring the construction of a new trap-and-haul facility. The total life cycle cost is estimated at $15,366,000. Constructing the trap-and-haul on the right bank alleviates some of the difficultly in maintaining uninterrupted trap-and-haul during construction. A right bank facility will also consolidate the hatchery and USACE fish trap into a single fishway. A fundamental drawback to this alternative is that the right bank of the river is on the opposite side of the main channel, which would result in significantly more difficult problems with bedload management. This is particularly true if the diversion is active.

3.4.2.3 Gaging Station Site

(a) General: The gaging station site is relatively remote, and the access is through a heavily wooded section. These conditions may delay hauling after storms as a result of road blockage and loss of power. The isolation of this site would increase the risk to vandalism. The gaging station site is likely a feasible site, but construction will be more difficult in the narrow river channel. Access is limited to the right bank unless an extensive road is constructed down from an existing logging road to the left bank.

The gaging station (and MMD) sites pose an additional problem of adult upstream migrant fish passage at the existing diversion site. This results in the need for a fish ladder to provide access to these upstream sites, which results in added delay to migratory fish. This ladder would be difficult to operate and maintain as a result of the bedload conditions in the river. The exit of this ladder would need to be located as far upstream of the diversion intake as possible in order to minimize adult fish fallback into the diversion. Even so, fallback is likely to be a problem and fish falling back into the PSE diversion will experience serious delays. The exit of this ladder would need to remain clear of bedload, which would likely require dredging, since a flushing gate is infeasible. The approximate cost of a ladder at the diversion site is estimated at $1,000,000.

The gaging station location allows for spawning by adult salmonids in a portion of the diversion reach between the existing diversion dam and the gaging station site. However, much of this reach is through a rather narrow canyon and the only tributary to which access would be restored is Red Creek. Off channel habitat utilization by juvenile salmon may be improved slightly by this direct access, however, these reaches are utilized by displaced juveniles spawned upstream. The gaging station site is less secure than the diversion dam site resulting

in an increased potential for poaching and vandalism. A new diversion dam and fish trap may provide an opportunity for improved design and layout. However, existing physical and hydrological conditions at the site increase the likelihood of sedimentation and flood damage to the dam, trap or access road resulting in increased operation and maintenance concerns.

(b) Alternative 4: This alternative is the most costly alternative at this site with a total life cycle cost estimated at $13,008,000. If the diversion continues, the cost will increase in excess of $1,000,000 with the additional cost of adding and operating a fish ladder around the diversion site. The rubber weirs are operated either fully inflated or fully deflated and provide less control than large and small radial gates. This alternative results in the lowest headwater conditions during high river flow, although upstream flooding is not anticipated to cause significant erosion problems on the canyon walls.

(c) Alternative 5: This alternative is the second least costly of the alternatives at this site with a total life cycle cost estimated at $11,376,000. If the diversion continues the cost will increase in excess of $1,000,000 with the additional cost of adding and operating a fish ladder around the diversion site. The second gate will provide increased capacity for passing bedload during high river flow. This alternative results in moderately high headwater conditions during high river flow.

(d) Alternative 6: This alternative is the least costly of the alternatives at this site with a total life cycle cost estimated at $10,388,000. If the diversion continues the cost will increase in excess of $1,000,000 with the additional cost of adding and operating a fish ladder around the diversion site. The single gate at this site may not pass sufficient bedload through the relatively narrow channel at this site, therefore this alternative is considered to be the least efficient in passing sediment at this location. This alternative also results in the highest headwater conditions during high river flow.

3.4.2.4 MMD Site

(a) General: This site has serious drawbacks relating to reliability. Access may be compromised due to weather. The facility relies on a pumped water supply in order maintain trap operation. It also entails the longest haul route. Turbulent conditions at the MMD site may result in very poor conditions for attracting fish under all but very low flow conditions. This is a serious feasibility concern for the alternative. Power cost for the operation is significantly more at the MMD site where pumping is required. The site does have the advantage of being within the limits of the MMD project and being relatively close to the MMD operations center.

Similar to the gaging station site, the MMD site results in the need for a fish ladder at the diversion site as described in section 3.4.2.3 (a).

The MMD site maximizes mainstem spawning and juvenile rearing habitat by allowing unimpeded access to the mainstem, the canyon and all existing tributaries. However, flow variability, hydrologic characteristics and a limited area for fish hauling operations at MMD represent a real concern for fish attraction and trap efficiency. Support for hatchery operations is extremely limited and road access is less reliable due to steep grades, especially during adverse weather.

(b) Alternative 7A: This is the least costly alternative, but has the greatest potential for access problems, especially during adverse weather when the haul truck must navigate down the steep road on the downstream face of the dam embankment. The total life cycle cost is estimated at $9,349,000. If the diversion continues the cost will increase in excess of $1,000,000 with the additional cost of adding and operating a fish ladder around the diversion site.

(c) Alternative 7B: This variation of alternative 7 alleviates potential access problems down the steep road down the face of the dam by including a gondola lift for the hopper, however the operation still requires someone down at the trap and the gondola would add an extra mechanical feature in the sequence of tasks necessary for fish passage during adverse weather. The total life cycle cost is estimated at $11,201,000. If the diversion continues the cost will increase in excess of $1,000,000 with the additional cost of adding and operating a fish ladder around the diversion site.

3.4.3 Conclusions

Seven fish collection and transport alternatives at different locations were considered and evaluated as part of the plan formulation of this study. Three were at the existing site, three were at a USGS gaging station located 4.5 miles downstream of Mud Mountain Dam (MMD), and two were located at the toe of MMD. The construction cost as well as the 50-year present worth value of O&M are based on the ten percent level of design. They have a contingency level of 30 percent and are based on the costs presented in Table 3-2, Alternatives Comparison Matrix, and are shown in Table 3-4, Cost Sumary. Alternative 1 was selected as the federally preferred alternative. Although all of the criteria were important in formulating and evaluating alternatives the criteria that most differentiated the alternatives include an alternative's ability to pass bedload, the reliability of the alternative's fish passage operations, the mechanical reliability of structure, and the value of spawning habitat between the existing structure and MMD. Following is the rationale for selecting this alternative.

Table 3-4 Cost Summary

Site	Construction Cost	OMR&R	Total Cost
Diversion Dam			
Alternative 1	$10,963,000	$2,281,000	$13,244,000
Alternative 2	$11,597,000	$3,116,000	$14,713,000
Alternative 3	$12,307,000	$3,060,000	$15,367,000
Gaging Station			
Alternative 4	$10,256,000	$2,752,000	13,008,000$
Alternative 5	$8,899,000,	$2,477,000	$11,376,000
Alternative 6	$8,219,000	$2,169,000	$10,388,000
MMD			
Alternative 7a	$6,707,000	$2,645,000	$9,349,000
Alternative 7b	$8,168,000	$3,033,000	$11,201,000

3.4.3.1 Eliminated Alternatives

(a) Alternative 4: Based on a preliminary analysis of cost alone, Alternatives 4 through 8 all have a lower cost than Alternative 1. It should be noted that Alternatives 4 through 8 do not include costs for PSE diversion dam fish ladder, which provides a way for the returning adults to migrate past the existing diversion dam to reach the new fish collection facility at either the gaging station or toe of Mud Mountain Dam. A fish ladder at the existing diversion structure will cost an estimated $1,000,000. As such, the construction costs for Alternatives 4 through 7 needs to be increased by $1,000,000. Based on cost alone, this eliminates alternative 4.

(b) Alternative 6: While providing the ability to trap-and-haul fish, this alternative has only a single gate, which raises sediment and bedload passage concerns through the relatively narrow channel at this site. In addition, this alternative also results in the highest headwater conditions during high river flows. Further, this alternative is isolated from the power grid, prone to access problems, and is isolated and difficult to monitor. This alternative does not meet the engineering planning objectives for passing bed load and was eliminated from further consideration.

(c) Alternative 7a: This alternative is located at the toe of MMD. All of the other alternatives provide water for the fish ladder operation that is not available in this alternative. As a result, water must be continuously pumped from the river to the fish ladder and a mechanical or power failure would result in no water entering the fish ladder. The 9-foot-diameter outlet from MMD would discharge next to the ladder entrance and likely result in false attraction water – reducing the ability to effectively trap fish. Also, because this alternative is located close to the MMD outlet works, the water is often highly turbulent. The truck access to this site would be down a 16 degree slope road making access to and from this site difficult and virtually impossible during bad weather (ice and snow). The likely success of the trap-and-haul operation is lowest with this alternative. Even though this alternative is the lowest cost, all of the above

negative features of this alternative resulted in it being eliminated from further consideration.

(d) Alternative 7b: This alternative is the same as Alternative 7a except a gondola would be used to move fish from the trap to the truck parked near the top of the dam. It would take at least two people to operate the gondola. All of the same negative aspects of Alternative 7 apply to this alternative, consequently this alternative was eliminated from further consideration.

(e) Alternative 5: Even with the cost of the fish ladder added, Alternative 5 is of lower cost than Alternative 1. The advantages of Alternative 1, versus Alternative 5 is that it is located at a proven site and has the highest probability of success in moving fish around MMD. Also, it is mechanically more reliable, so it is expected to have fewer mechanical failures than Alternative 5. This alternative, as well as all alternatives located away from the existing diversion dam area, is located further away from the Muckleshoot fish hatchery, which creates a longer distance for Chinook salmon transport to the hatchery. Although not an obligation related to the authorized project, supporting the tribal hatchery is a component of overall salmon recovery in the basin.

3.4.3.2 Reasons for Selecting Alternative 1 versus Alternative 5

(a) Alternative 1: This alternative is located at the existing diversion dam and is the least cost alternative at this site. This location, based on the historical operation of the existing trap-and-haul facility, provides the highest probability of success. It also provides a short haul distance for hatchery fish. As shown above, Alternatives 4, 6, 7a and 7b were eliminated from further consideration. Alternative 5 was not selected as the federally preferred alternative because: while it is estimated to cost $12,376,000 (including $1,000,000 for fish ladder at existing diversion dam) and Alternative 1 is estimated to cost $13,244,000, the difference in cost is within the contingency percentage and as such is considered to not to be a deciding factor. Equally important, the expected biological benefits of opening up spawning to Red Creek under Alternative 5 is outweighed by the sediment passage uncertainty and operational reliability of the gaging station site. Since Alternative 1 has the highest probability of successful trap-and-haul, and can be reliably operated, it is considered to be the most cost effective of the remaining alternatives and as such was the selected plan. In addition, it is expected that the federally preferred plan (Alternative 1) is the minimum facility that will be required under ESA. Alternative 1 is recommended for further development as the Federally Preferred Plan.

SECTION 4 -- Plan Selection – Federal vs. Local

4.1 SUMMARY OF ALTERNATIVES

4.1.1 General

This section presents the final phase of the plan formulation and evaluation framework, which further develops the Federally Preferred Plan and Locally Preferred Plan in order to determine cost allocation and which plan should go forward as the recommended plan. Following selection of Alternative 1 as the federally preferred plan in the 10% alternative evaluation, this plan and the Locally Preferred Plan were developed to the to the 35% design level. Components of each plan are summarized below. The intent of the federal plan is to identify a plan that addresses USACE's responsibility for fish passage, and does not preclude diversion. In general the Federally Preferred Plan incorporates a long section of ogee crest in addition to a 16-foot-wide radial gate in the barrier structure. The Locally Preferred Plan optimizes the performance of the diversion by providing more features that reduce entrainment of bedload into the canal. These features include: rubber weirs, a 35-foot-wide radial gate, and 16-foot-wide radial gate. Although the Federally Preferred Plan is not as effective at passing bedload, it is a significant improvement over the existing facility and can be configured to allow or abandon the diversion. Figures 4-1 and 4-2 depict the FPA and LPA respectively.

4.1.2 Federally Preferred Plan

The objective of this plan is to provide the most cost effective environmentally acceptable solution to ensure long-term safe and efficient fish passage at Mud Mountain Dam. Details of the Federally Preferred Plan are presented in the Appendix E – Design Considerations and in Appendix A – Cost Estimating. The cost estimate for this plan is more in depth and independent of the cost estimating prepared for Alternatives 1 through 7. The following summarizes the important aspects of the plan, including a physical description, operational description, and cost.

4.1.2.1 Physical Description

(a) Trap-and-Haul: The modifications to the trap-and-haul facilities consist of an upgrade to the USACE's existing left bank trap-and-haul facilities. Major improvements and modifications include: a new 130 cfs supply intake with fish screens, a screen cleaner and a sediment control pump; 70 cfs auxiliary attraction water supply with upstream control gates; and a new fish ladder entrance with entrance slot and entrance channel. The entrance is also extended further downstream. The fishway water supply intake will feature a concrete deck, slots for isolation stoplogs, and a debris handler (log loader) capable of removing large floating debris in front of the intake and 16-foot radial gate. Other improvments include retaining walls, intake guidewalls, grating, and handrails. The holding pool brail will be upgraded to a finer slot stainless steel brail. The pool will also include stainless steel "V" notches and a return flume to the tailwater for bypassing steelhead. A 25 cfs auxiliary water supply is also provided to the right bank hatchery fishway.

(b) Bypass Ramp Gate: This feature serves both to bypass fish and debris screened at the fishway intake and to bypass low flow, until a

TEMPORARY CONSTRUCTION EASEMENT

PROJECT PROPERTY LIMITS

RIGHT BANK LEVEE, 60' WIDE EASEMENT

WHITE RIVER

T.O.W. EL 678.0

SLAB EL 664.0

TOP OF WALL EL 678.0

TOP OF DIVIDER WALL EL 674.0

CONCRETE DECK

UPSTREAM LIMIT OF EXISTING BARRIER

FISH SCREEN FACILITIES

16' RADIAL GATE

BACKFILL AND SURFACE WITH CRUSHED ROCK UP TO CONCRETE WALLS

CONCRETE WALLS

JIB CRANE

HATCHERY FISHTRAP

HATCHERY FISHWAY

OGEE WEIR

BARRIER APRON

DOWNSTREAM LIMITS OF EXISTING BARRIER

HATCHERY FISHWAY ENTRANCE

BYPASS RAMP GATE

FISH TRAP ENTRANCE

CONTROL BUILDING

LOADING POOL

HOLDING POOL

FISH TRAP LADDER

PSE DIVERSION FLUME

KING COUNTY

PIERCE COUNTY

NOTES:
1 IN GENERAL THE FEDERAL ALTERNATIVE IS BASED ON THE ASSUMPTION THAT NO DIVERSION WILL OCCUR AT THE PSE INTAKE. HOWEVER, IF A DIVERSION IS REQUIRED, A "DIVERSION OPTION" IS PRESENTED ON THE INSERT. FOR COST COMPARISON PURPOSES, INTAKE FEATURES ASSOCIATED EXCLUSIVELY WITH THE DIVERSION ARE EXCLUDED FROM THE FEDERAL ALTERNATIVE COST.

LEGEND:

PROJECT PROPERTY LIMITS

TEMPORARY CONSTRUCTION EASEMENT

ACCESS AND LEVEE EASEMENTS

TOW EL 666.0

TOW EL 674.0

FEATURES EXCLUDED FROM FEDERAL COSTS

EXTENDED WALL

DIVERSION OPTION

SEE NOTE 1

FIGURE 4-1 FPA OVERALL SITE PLAN

SCALE: 1"=50'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE OVERALL SITE PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	—		23

DSGN: F.E.P. | CHK: D.E.D. | SHEET 23 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\fig 4-1 plotted.dgn DATE AND TIME PLOTTED: 30-MAR-2005 08:37

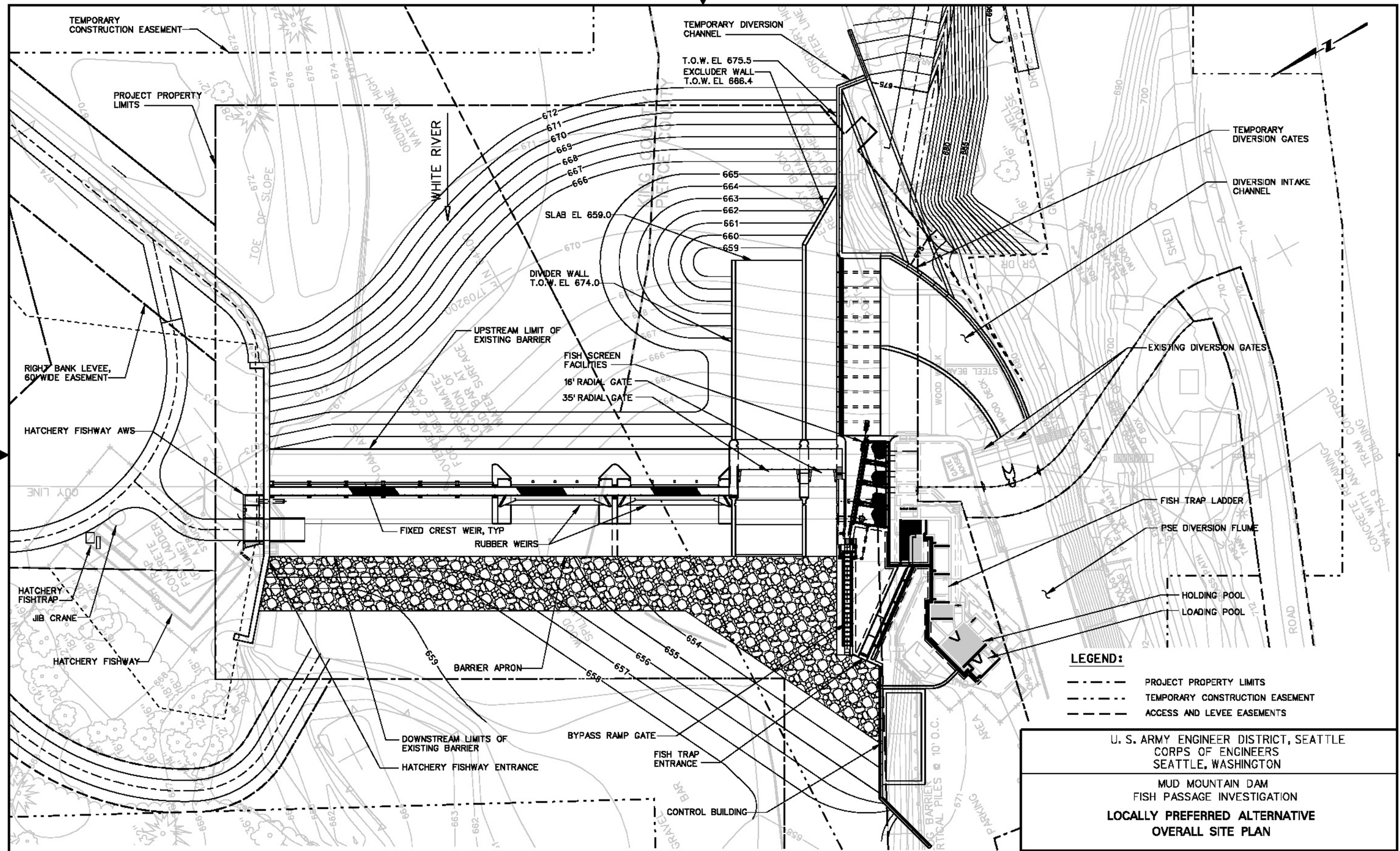


FIGURE 4-2 LPA OVERALL SITE PLAN

SCALE: 1"=50'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
OVERALL SITE PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		2

DSGN: F.E.P. | CHK: D.E.D. | SHEET 2 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\fig 4-2 plate02.dgn TIME PLOTTED: 30-MAR-2005 08:21

minimum opening on the 16-foot radial gate can achieved. The bypass ramp gate will pass the required 280 cfs when the gate is in the fully down position.

(c) Sediment Control: To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located immediately behind the fish screen. This pump will discharge water through manifolds placed along the invert of the structure to create high velocity jets. The jets will re-suspend sediment for flushing from the fish trap system.

(d) 16-foot Radial Gate: A 16-foot radial gate is located directly downstream from the supply intake for the fish screens. The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screen intake. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris. During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000 cfs tailwater elevation. This prevents apron submergence throughout the river flow range for which the trap operation is optimized.

(e) 35-foot Radial Gate: The 16-foot radial gate may not provide adequate capacity for passing bedload through the barrier. To create a wider flow path of high velocity flow, a second 35-foot-wide radial gate is likely to be be required. The confirmation for the need for a second gate will be addressed during 65% level design. This added feature has been included in project costs, but has not been included in the drawings. Hydraulic considerations for the additional gate are included in the H&H appendix (Appendix C).

(f) Ogee Weir: An ogee shaped concrete weir spans approximately 300 feet across the river channel between the radial gate pier and the right bank abutment, replacing the existing flashboard system. The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier. During high flow conditions when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000 cfs tailwater elevation preventing submergence during the river flow range when the trap is operated.

(g) Maintenance Deck: A maintenance deck is included in the cost and described in Section 6.

(h) Right bank Levee: This plan results in an elevated headwater during high flow events. Consequently, levee improvements will be provided along the right bank to prevent flooding of the Muckleshoot Hatchery during extreme flow events The levee is designed to

maintain a 2.5-foot freeboard for flood events up to 12,000 cfs river flow. The 12-foot-wide crest of the levee will function as a service road along the right bank. The riverside slope of the levee will be faced with riprap to prevent erosion during high flow events. The current levee layout may result in disturbing an existing riparian area with a portion of the levee. Future design work needs to clearly delineate the boundary of the riparian zone. Disturbance by the levee can be minimized or eliminated by shifting the levee to the north.

(i) Equipment Building: This building includes an equipment room for housing the hydraulic power unit and for storage. This building also houses the electrical and control equipment, a dining area, a restroom, and a locker area.

4.1.2.2 Construction: Construction of this plan will require placing cofferdams in three phases in order to pass the anticipated river flow around the work area during construction. Coordination of low flow and high background river turbidity conditions (typically occurring in August and September) may be necessary in order to minimize impacts to the river water quality while installing and removing cofferdams. Onsite material is anticipated to be used for the majority of the backfill and for construction of the cofferdam cores. Nearly uninterrupted operation of the fish trap will be provided. However, some interruption will be inevitable. At least one of the traps on the right bank or left bank will remain in operation at a time.

4.1.2.3 Operations

(a) Flow: The flow control operational schedule for Federally Preferred Plan is presented below in Table 4-1 titled, “Federally Preferred Plan - Flow Ranges”. During normal conditions the combined facilities will be operated to maintain a head water elevation (HWEL) 671.5 to 672.8 in feet above mean sea level (fmsl). The table also presents the tailwater elevations (TWEL) corresponding to the flow.

Table 4-1. Federally Preferred Plan - Flow Ranges

	Flow Ranges (cfs)							
		Fish Trap				Fish Bypass Ramp Gate	16' Radial Gate	303' Ogee Crest
	TOTAL RIVER	Ladder	AWS	Hatchery Supply	TOTAL			
From	180	35	70	25	130	50	0	0
To	550	35	70	25	130	400	0	0
From	550	35	50	25	130	20	400	0
To	2750	35	70	25	130	20	2600	0
From	2750	35	70	25	130	20	2600	0
To	12000	0	0	0	0	12000		

	HWEL	*TWEL*	*dWSEL*	*Description*
From	671.5	658.6	12.9	Trap open, bypass ramp gate adjusted to maintain HWEL 671.5, gate closed.
To	671.5	659.6	11.9	
From	671.5	659.6	11.9	Trap open, minimum bypass flow, gate operated (open min 0.8 feet) to maintain HWEL 671.5, AWS flow initially trimmed to 50 cfs.
To	671.5	662.6	8.9	
From	671.5	659.6	11.9	Trap initially open then closing around 6,000 cfs, maximum bypass flow, gate fully open, HWEL rises and eventually spill over ogee.
To	678.3	670.5	7.8	

(b) Trap-and-Haul: As described in the criteria (see Section 2), the modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000 cfs. During river flows less than 130 cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000 cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000 cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap. Similar to existing trap-and-haul operations, between 25 and 35 cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4 feet, respectively. Up to 70 cfs will be delivered through the AWS channel to the trap entrance as supplementary attraction flow. Up to 25 cfs of this remaining flow will be delivered to the right bank hatchery ladder for attraction flow at the ladder entrance. The adjustable crest entrance slot will be

operated to optimize the discharge jet for fish attraction during variable tailwater conditions. In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel fish trapped in the holding pool into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks will likely use established haul routes for transporting the adult fish to an unloading site upstream of MMD. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) 16-foot Radial Gate: As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. The gate will be operated to maintain the normal operating pool level, HWEL 671.5. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. To minimize harm to downstream migrant fish, the operation of the radial gate is subject to a minimum gate opening of 0.8 feet.

(d) 35-foot Radial Gate: The hydraulic appendix includes an operational evaluation with the 35-foot gate in place.

(e) Ogee Weir: The ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and will not require any active operation. As discussed previously, it is expected that bedload movement will ultimately raise the riverbed behind the weir to nearly crest level.

4.1.2.4 Capital Cost: The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 4-2, "Federally Preferred Plan – Capital Cost Summary". This estimate is organized by a breakdown of the major project features. Details of this estimate are presented in Appendix A – Cost Estimate. An additional sum of $60,000 is required to fund a bedload passage study for the site. Note, if the diversion continues to operate then a portion of the proposed retaining wall, fill material, and, gate closure wall would be unnecessary and reduction in cost of $189,000 would be made from the cost listed in Table 4-2. No cost for improvements, which are exclusive to diversion improvements are included in the Federally Preferred Plan.

4.1.2.5 Operation and Maintenance Costs: Operation and maintenance costs are estimated over a 50-year project life and presented in Table 4-3, titled "Federally Preferred Plan - Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

Table 4-2 Federally Preferred Plan - Contract Cost Summary

THIS ESTIMATE IS BASED ON THE SCOPE OF WORK FOR THE SECTION 205 REPORT

PROJECT: **MMD FISH PASSAGE** DISTRICT: SEATTLE 22-Oct-04

LOCATION: **White River, Washington** P.O.C.: TIM SULLIVAN, LEAD, COST ENGINEERING SECTION

		CURRENT MCACES ESTIMATE PREPARED:					AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
		EFFECTIVE PRICING LEVEL: Oct-02					EFFECT. PRICING LEVEL: 1 OCT 02								
ACCOUNT NUMBER		FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)		COST ($K)	CNTG ($K)	TOTAL ($K)	SPENT FY ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
FEDERALLY PREFERRED ALTERNATIVE																
06		FISH AND WILDLIFE FACILITIES														
		Temporary Consruction	1,160	174	15%	1,334	0.0%	1,160	174	1,334		Jul-08	6.3%	1,233	185	1,418
		Demolition	763	114	15%	877	0.0%	763	114	877		Jul-08	6.3%	811	122	933
		Earthworks	252	38	15%	290	0.0%	252	38	290		Jul-08	6.3%	268	40	308
		Right Bank Fishway Entrance	191	29	15%	220	0.0%	191	29	220		Jul-08	6.3%	203	30	233
		Ogee Weir	1,261	189	15%	1,450	0.0%	1,261	189	1,450		Jul-08	6.3%	1,340	201	1,542
		16' Radial Gate	805	121	15%	926	0.0%	805	121	926		Jul-08	6.3%	856	128	984
		Fish Screen & Fish Trap Improvements	1,670	251	15%	1,921	0.0%	1,670	251	1,921		Jul-08	6.3%	1,775	266	2,041
		Fish Screen Intake	363	54	15%	417	0.0%	363	54	417		Jul-08	6.3%	386	58	444
		Incidentals	40	6	15%	46	0.0%	40	6	46		Jul-08	6.3%	43	6	49
		Buildings	116	17	15%	133	0.0%	116	17	133		Jul-08	6.3%	123	18	142
		Specialized Equipment	876	131	15%	1,007	0.0%	876	131	1,007		Jul-08	6.3%	931	140	1,071
		Maitenance Deck	879	132	15%	1,011	0.0%	879	132	1,011		Jul-08	6.3%	934	140	1,075
		35' Radial Gate	1,391	209	15%	1,600	0.0%	1,391	209	1,600		Jan-00	6.3%	1,479	222	1,700
		TOTAL CONSTRUCTION COSTS	**9,767**	**1,465**		**11,232**		**9,767**	**1,465**	**11,232**				**10,382**	**1,557**	**11,940**
01		LANDS AND DAMAGES														
		Real Estate	663	99	15%	762	0.0%	663	99	762		Jul-06	1.3%	672	101	772
20---		PERMANENT MAINTENANCE EQUIPMENT	149	22	15%	171	0.0%	149	22	171		Jul-08	8.4%	162	24	186
30---	**27%**	PLANNING, ENGINEERING AND DESIGN	2,598	390	15%	2,987	0.0%	2,598	390	2,987		Apr-04	1.3%	2,631	395	3,026
		Project Management														
		Planning & Environmental Compliance														
		Engineering & Design														
		Engineering Tech Review & VE														
		Real Estate Planning														
		Engineering During Construction														
		Environmental Monitoring:														
31---	**10%**	CONSTRUCTION MANAGEMENT	977	98	10%	1,074	0.0%	977	98	1,074		Jul-08	8.4%	1,059	106	1,165
	6.5%	Construction Management														
	1.0%	Project Operation:														
	2.5%	Project Management														
		TOTAL PROJECT COSTS	**14,153**	**2,074**		**16,228**		**14,153**	**2,074**	**16,228**				**14,906**	**2,183**	**17,088**

(a) Fish Trap Operation: Includes operating the trap-and-haul 3 days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control. Significant upgrades to the existing fish trap facility are allowed on a 16-year interval, twice over the 50 year life.

(b) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

(c) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate. Power cost for the gate is also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with the “log loader” and minor dredging. Rehabilitation of the radial gate is allowed on a 16-year interval, twice over the 50 year life. This includes painting, seal replacment, and rehabilitation of the hydraulic operators.

Table 4-3. Federally Preferred Plan – Operation and Maintenance Costs
50 Year Life Cycle

System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Replacement Costs	Total Present Value of O&M and Replacement Cost
		0.06 $/kWhr	2003 $	2003 $ 5.875%
Fish Trap Operation:				
Fish Trap and Haul	112,640			1,806,865
Sediment Control	24,960	350		406,006
Screen Cleaning	3,120	1,007		66,208
General Lights and Control		44		703
Fish Trap Maintenance				
Fish Trap and Haul			142,274	79,968
Fish Truck Maintenance	3,000		100,000	104,330
Sediment Control			95,581	53,723
Screen Cleaning			132,957	74,731
Bypass Ramp Gate			108,902	61,210
Annual Inspection	6,300			101,059
Repairs	11,600			186,076
Dam Operation and Maintenance				
16' Radial Gate	8,300	153	52,000	164,827
35' Radial Gate	9,420	153	100,000	209,773
Debris Management	31,800			510,106
Bedload Management	4,400			70,581
Totals	215,540	1,708	731,714	3,896,165

4.1.2.6 Total Life Cycle Cost: The total 50-year life cycle cost for the Federally Preferred Plan is the total of the capital costs and the operation and maintenance costs. This total is $20,984,000

4.1.3 Locally Preferred Alternative

4.1.3.1 General: The objective of this plan is to optimize conditions for operating the diversion while providing an environmentally acceptable solution to ensure long-term safe and efficient fish passage at Mud Mountain Dam. Details of the Locally Preferred Plan are presented in the Appendix E – Design Considerations and in Appendix A – Cost Estimating. The cost estimate for this plan is more in depth and independent of the cost estimating prepared for the preliminary screening of Alternatives 1 through 7. This plan's antecedent is the Reference Plan. The following summarizes the important aspects of plan, including a physical description, operational description, and cost.

4.1.3.2 Physical Description

(a) Trap-and-Haul: The modifications to the trap-and-haul facilities consist of an upgrade to the USACE's existing left bank trap-and-haul facilities. Major improvements and modifications include: a new 130 cfs supply intake with fish screens, a screen cleaner and a sediment control pump; 70 cfs auxiliary attraction water supply with upstream control gates; and a new fish ladder entrance with entrance slot and entrance channel. The entrance is also extended further downstream. The fishway water supply intake is common with the diversion intake, which features a concrete deck, slots for isolation stoplogs, and a debris handler (log loader) capable of removing large flooding debris in front of the intake and 16-foot radial gate. Additional features of the diversion include curved flow training walls, retaining walls, headgate refurbishment, and hydraulic controls for the headgates. The holding pool brail will be upgraded to a finer slot stainless steel brail. The pool will also include stainless steel "V" notches and a return flume to the tailwater for bypassing steelhead. A 25 cfs auxiliary water supply is also provided to the right bank hatchery fishway.

(b) Bypass Ramp Gate: This feature serves both to bypass fish and debris screened at the fishway intake and to bypass low flow, until a minimum opening on the 16-foot radial gate can achieved. This gate will pass the required 420 cfs when in the fully down position.

(c) Sediment Control: To manage sediment deposition within the forebay and throughout the fishway trap, a sediment control pump is located immediately behind the fish screen. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will re-suspend sediment for flushing from the fish trap system.

(d) Radial Gates: A 16-foot radial gate is located directly downstream from the supply intake for the fish screens and a 35-foot gate is located immediately to the right. These gates will be used to remobilize bedload and debris that have accumulated in front of the diversion (and fish screen) intake. Training walls extend upstream from the radial gate piers, parallel to the face of the intake. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake when the gates are

operated, enhancing mobilization of accumulated bedload and debris. During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000 cfs tailwater elevation. This prevents apron submergence throughout the river flow range for which the trap operation is optimized.

(e) Rubber Weir: Two identically sized inflatable rubber weirs are located to the right of the 35-foot radial gate. When fully inflated, each rubber weir crest spans 50 feet and has a crest elevation of 672.5. The flat spillway apron directly below the rubber weirs is set at EL 663.8 resulting in a crest-to-apron height of 8.7 feet. The final downstream 15 feet of the apron slopes to EL 662.3 corresponding with the 4,000 cfs tailwater level. As with the ogee weir and radial gate, the apron remains unsubmerged during the normal river flow range when the trap is operated. The height of the rubber weirs in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier. A 12-foot-wide service bridge from the left bank spans the radial gate, ogee crest and first rubber weir to provide service access to both rubber weirs.

(f) Fixed Crests: The fixed-crest panel section of the barrier is located between the right pier of the second rubber weir and the right riverbank abutment. This section is composed of six removable fixed-crest concrete panels. The section of removable panels is provided for bypassing river flows during construction of the remaining barrier components. Once construction is complete, these panels would be installed more or less as permanent fixtures. Each panel measures 19-feet-long by 9-feet-high with crests set at EL 672.8. The spillway apron below the panels is similar to that for the rubber weirs. The flat invert directly below the panels is set at EL 663.8 with the final 15 feet sloping to EL 662.3. The apron remains un-submerged during the river flow range when the trap is operated. As with the rubber weirs, the height of the fixed-crest panels in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier even when the weirs are being overtopped.

(g) Right bank Levee: This plan results in lower headwater conditions than the existing barrier during high flow events. However, levee improvements will be provided along the right bank to prevent flooding of the Muckleshoot Hatchery during extreme flow events. The levee is designed to maintain a 2.5-foot freeboard for flood events up to 12,000 cfs river flow. The 12-foot-wide crest of the levee will function as a service road along the right bank. The riverside slope of the levee will be faced with riprap to prevent erosion during high flow events. The current levee layout may result in disturbing an existing riparian area with a portion of the levee. Future design work needs to clearly delineate the boundary of the riparian zone. Disturbance by the levee can be minimized or eliminated by shifting the levee to the north. If a second 35-foot

radial gate is added to this project, then the required levee height and size will be reduced.

(h) Equipment Building: This building includes an equipment room for housing the hydraulic power unit, air compressors for the rubber weirs, and for storage. This building also houses the electrical and control equipment, a dining area, a restroom, and locker area.

4.1.3.3 Construction: Construction of this plan will require placing cofferdams in two phases in order to pass the anticipated river flow around the work area during construction. Additionally, flow will need to be diverted into the diversion flume during high flow events. Coordination of low flow and high background river turbidity conditions (typically occurring in August and September) may be necessary in order to minimize impacts to the river water quality while installing and removing cofferdams. Onsite material is anticipated to be used for the majority of the backfill and for construction of the cofferdam cores. Nearly uninterrupted operation of the fish trap will be provided, however some interruption will be inevitable. At least one of the traps on the right bank or left bank will remain in operation at a time.

4.1.3.4 Operation

(a) Flow: The flow control operational schedule for Locally Preferred Plan is presented below in Table 4-4 titled, “Locally Preferred Plan - Flow Ranges”. During normal conditions the combined facilities will be operated to maintain a head water elevation (HWEL) 671.5 to 672.8 in feet above mean sea level (fmsl). The table also presents the tailwater elevations (TWEL) corresponding to the flow.

Table 4-4. Locally Preferred Plan - Flow Ranges

	Flow (cfs)									
		Fish Trap				Bypass Ramp Gate	16' Radial Gate	35' Radial Gate	Rubber Weirs	Fixed Crest Panels
	TOTAL RIVER	Ladder	AWS	Hatchery Supply	TOTAL					
From	180	35	70	25	130	50	0	0	0	0
To	550	35	70	25	130	420	0	0	0	0
From	550	35	70	25	130	20	400	0	0	0
To	1080	35	70	25	130	20	0	930	0	0
From	1080	35	70	25	130	20	0	930	0	0
To	4020	35	70	25	130	20	0	3850	0	0
From	4020	0	0	0	0	20	0	4000	0	0
To	7300	0	0	0	0	0	0	7300	0	0
From	7300	0	0	0	0	0	0	7300	0	0
To	10290	0	0	0	0	0	2920	7370	0	0
From	10290	0	0	0	0	0	2920	7370	0	0
To	18750	0	0	0	0	18750				0

	HWEL	*TWEL*	*dWSEL*	*Description*
From	671.5	658.6	12.9	Trap open, bypass ramp gate adjusted to maintain HWEL 671.5, both gates closed, rubber weirs inflated.
To	671.5	659.6	11.9	
From	671.5	659.6	11.9	Trap open, minimum bypass flow, 16' gate operated (open min 0.8 feet) to maintain HWEL 671.5, AWS flow initially trimmed to 50 cfs, 35-foot gate closed, rubber weirs fully inflated.
To	671.5	662.6	8.9	
From	671.5	662.6	8.9	Trap open, minimum bypass flow, both gates operated (min 0.8 feet open) in tandem to maintain HWEL 671.5, rubber weirs inflated.
To	671.5	664.4	7.1	
From	671.5	664.4	7.1	Trap closed, up to max bypass flow, both gates fully open, rubber weirs operated in tandem to maintain HWEL 671.5 until deflated, eventually HWEL rises until spill over fixed crest panels.
To	672.5	670.5	2.0	

(b) Trap-and-Haul: As described in the criteria (see Section 2), the modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000 cfs. During river flows less than 130 cfs, the trap could be closed and all flow will pass

over the ogee weir. During river flows exceeding 4,000 cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000 cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap. Similar to existing trap-and-haul operations, between 25 and 35 cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4 feet, respectively. Up to 70 cfs will be delivered through the AWS channel to the trap entrance as supplementary attraction flow. Up to 25 cfs of this remaining flow will be delivered to the right bank hatchery ladder for attraction flow at the ladder entrance. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions. In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel fish trapped in the holding pool into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks will likely use established haul-routes for transporting the adult fish to an unloading site upstream of MMD. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) Radial Gates: The primary purpose of the radial gates is to minimize the accumulation of bedload and debris in front of the diversion and fish screen intake. The gates will be operated to maintain the normal operating pool level, HWEL 671.5. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gates will remain fully open. The operation of the radial gates is subject to a minimum gate opening to minimize harm to downstream migrant fish of 0.8 feet.

(d) Rubber Weirs: The two inflatable rubber weirs will either be fully inflated or completely deflated. During high flow events the weirs will be deflated to minimize headwater conditions and contribute to passing bedload and debris past the barrier.

(e) Fixed Crests: As described previously, the removable fixed-crest panels are provided primarily for construction purposes. However, they could potentially be removed to bypass river flow around the barrier during major maintenance, repairs and/or upgrades of the other barrier components. Additionally, they could potentially be removed to remobilize bedload accumulations upstream. Otherwise, the fixed-crest panels are effectively a fixed structure and will generally function passively and not require any active operation.

4.1.3.5 Capital Cost: The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 4-5, "Locally Preferred Plan – Capital Cost Summary". This estimate is organized by a breakdown of the major project features. Details of this estimate are presented in Appendix A – Cost Estimate.

Table 4-5 Locally Preferred Plan - Contract Cost Summary

THIS ESTIMATE IS BASED ON THE SCOPE OF WORK FOR THE SECTION 205 REPORT

PROJECT: **MMD FISH PASSAGE** DISTRICT: SEATTLE 22-Oct-04

LOCATION: **White River, Washington** P.O.C.: TIM SULLIVAN, LEAD, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Oct-02 EFFECT. PRICING LEVEL: 1 OCT 02

ACCOUNT NUMBER		FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)		COST ($K)	CNTG ($K)	TOTAL ($K)	SPENT FY ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
LOCALLY PREFERRED ALTERNATIVE																
06		FISH AND WILDLIFE FACILITIES														
		Temporary Consruction	713	107	15%	820	0.0%	713	107	820		Jul-08	6.3%	758	114	872
		Demolition	829	124	15%	953	0.0%	829	124	953		Jul-08	6.3%	881	132	1,013
		Earthworks	294	44	15%	338	0.0%	294	44	338		Jul-08	6.3%	313	47	359
		Right Bank Fishway Entrance	191	29	15%	220	0.0%	191	29	220		Jul-08	6.3%	203	30	233
		Fixed Crest Weir	643	96	15%	739	0.0%	643	96	739		Jul-08	6.3%	684	103	786
		Rubber Weirs	1,929	289	15%	2,218	0.0%	1,929	289	2,218		Jul-08	6.3%	2,051	308	2,358
		35' Radial Gate	1,391	209	15%	1,600	0.0%	1,391	209	1,600		Jul-08	6.3%	1,479	222	1,700
		16' Radial Gate	761	114	15%	875	0.0%	761	114	875		Jul-08	6.3%	809	121	930
		Fish Screen & Fish Trap Improvements	1,670	251	15%	1,921	0.0%	1,670	251	1,921		Jul-08	6.3%	1,775	266	2,041
		Diversion Intake	1,393	209	15%	1,602	0.0%	1,393	209	1,602		Jul-08	6.3%	1,481	222	1,703
		Incidentals	40	6	15%	46	0.0%	40	6	46		Jul-08	6.3%	43	6	49
		Buildings	116	17	15%	133	0.0%	116	17	133		Jul-08	6.3%	123	18	142
		Specialized Equipment	910	137	15%	1,047	0.0%	910	137	1,047		Jul-08	6.3%	967	145	1,112
		Maitenance Deck	879	132	15%	1,011	0.0%	879	132	1,011		Jul-08	6.3%	934	140	1,075
		TOTAL CONSTRUCTION COSTS	**11,759**	**1,764**		**13,523**		**11,759**	**1,764**	**13,523**				**12,500**	**1,875**	**14,375**
01		LANDS AND DAMAGES	Estimate was not developed for the Locally Preferred Plan. The line item amount shown is the estimate for the Federal Plan. The two plans are very similar.													
		Real Estate	663	99	15%	762	0.0%	663	99	762		Jul-06	1.3%	672	101	772
20---		PERMANENT MAINTENANCE EQUIPMENT	149	22	15%	171	0.0%	149	22	171		Jul-08	8.4%	162	24	186
30---		PLANNING, ENGINEERING AND DESIGN	2,700	405	15%	3,105	0.0%	2,700	405	3,105		Apr-04	1.3%	2,735	410	3,145
		Project Management														
		Planning & Environmental Compliance														
		Engineering & Design														
		Engineering Tech Review & VE														
		Real Estate Planning														
		Engineering During Construction														
		Environmental Monitoring:														
31---	**11%**	CONSTRUCTION MANAGEMENT	1,282	128	10%	1,410	0.0%	1,282	128	1,410		Jul-08	8.4%	1,389	139	1,528
	7.0%	Construction Management														
	1.9%	Project Operation:														
	2.0%	Project Management														
		TOTAL PROJECT COSTS	**16,553**	**2,419**		**18,972**		**16,553**	**2,419**	**18,972**				**17,457**	**2,549**	**20,006**

4.1.3.6 Operation and Maintenance Costs: Operation and maintenance costs are estimated over a 50-year project life and presented in Table 4-6, titled "Locally Preferred Plan - Operation and Maintenance Cost – 50 year Life Cycle." The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

(a) Fish Trap Operation: Includes operating the trap-and-haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control. Significant upgrades to the existing fish trap facility are allowed on a 16-year interval, twice over the 50 year life.

(b) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

(c) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gates, rubber weirs, and head gates. Power cost for the radial gates, rubber weirs, and head gates are also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with the "log loader" and minor dredging. Replacement of the rubber dams, and rehabilitation of the radial gates and head gates are allowed on a 16-year interval, twice over the 50 year life. Rehabilitation includes painting, seal replacement and rehabilitation of the hydraulic operators.

Table 4-6. Locally Preferred Plan – Operation and Maintenance Costs
50-Year Life Cycle

System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Rehabilitation Costs	Total Present Value of O&M and Replacement Cost
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				
Fish Trap and Haul	107,840			1,729,868
Sediment Control	24,960	350		406,006
Screen Cleaning	3,120	1,007		66,208
General Lights and Control		44		703
Fish Trap Maintenance				
Fish Trap and Haul			142,274	79,968
Fish Truck Maintenance	3,000	-	100,000	104,330
			95,581	53,723
			132,957	74,731
			108,902	61,210
Annual Inspection	6,300			101,059
Repairs	11,600			186,076
Dam Maintenance				
16' Radial Gate	8,300	153	52,000	164,827
35' Radial Gate	9,420	153	100,000	209,773
Rubber Dam	7,620	66	674,903	502,629
Head Gates	35,900	1,095	20,000	604,680
Debris Management	34,200			548,604
Bedload Management	4,400			70,581
Totals	256,660	2,869	1,426,617	4,964,976

4.1.3.7 Total Life Cycle Cost: The total 50-year life cycle cost for the Locally Preferred Plan is the total of the capital costs and the operation and maintenance costs. The total is $24,945,000.

4.2 COMPARISON OF PLANS

4.2.1 General

In general the two alternatives are relatively similar, having used the same basic design. The Federally Preferred Plan places an emphasis on fish passage, whereas the Locally Preferred Plan optimizes diversion performance. The following are comparisons in the context of the original planning objectives.

4.2.2 Fish Barrier

Both plans provide adequate velocity across an apron of adequate length to prevent even the most athletic fish from passing upstream. Although some of the features do not achieve velocities in excess of the maximum burst speed, they do achieve high velocities over a long enough length so that a fish maintaining maximum burst for the maximum time of 10 seconds will not pass the barrier, but will be swept back.

4.2.3 Gravity Fish Trap Water Supply

Gravity supply is achieved by both plans to operate the traps throughout the criteria range up to 4,000 cfs and even during flow events up to 8,000 cfs

4.2.4 Criteria Screening of Fish Trap Water Supply

Both plans provide criteria screening of the supply water for the fish trap. However, the Locally Preferred Plan (or the Federally Preferred Plan with a diversion) results in more turbulent flow conditions at the screen. This will make the screen more difficult to balance and may result is “hot spots” (locations of high approach velocity). Design modifications may be necessary to improve the fish screen intake flow conditions.

4.2.5 Bedload Passage

Both plans incorporate radial gates for flushing bedload and maintaining a clear intake. Each of the gate channels are steel lined to protect the channel and promote the movement of bedload downstream.

The Federally Preferred Plan is designed to maintain a clear intake while diverting 130 cfs at river flow greater than 430 cfs. When flow is in excess of 2,600 cfs the 16-foot gate will be nearly wide open and velocity will be in the range of 11 to 19 fps through the channel. The lower velocity occurs during river flow in excess of 4,000 cfs passing over the ogee weir. Additional hydraulic evaluation is needed if an additional 35-foot radial gate is confirmed to be needed in the Federally Preferred Plan to better pass bedload. This additional gate will allow flushing to occur on the left bank of the river in a manner that flow has historically occurred during high flow conditions with the flash boards down.

The Locally Preferred Plan was developed using a physical model to optimize the exclusion of bedload from the intake while diverting up to 2,000 cfs.

4.2.6 Fish Trap Sediment Control

Both plans include a sediment control system to re-suspend sediment deposition upstream and downstream of the fish screen and within the fish trap. (Refer to Section 6.3.7 in Appendix E.)

4.2.7 Adequate Flood Control

The two alternative plans include approximately 800 lineal feet of levee, upstream of the diversion dam, along the right bank of the river. These levees provide protection for the Muckleshoot Fish Hatchery for flood events up to 12,000 cfs, with 2.5 feet of freeboard. The Federally Preferred Plan results in a higher headwater than the Locally Preferred Plan and requires a larger levee. Although the levee will provide protection against surface water flow, groundwater seepage is still a concern. The following evaluation was performed to better understand the problem.

Figure 4-3 "Flooding Concerns Plan" depicts the area of the river and Muckleshoot fish hatchery that would be affected by seepage. This plan includes the area below elevations 677, which is the water level in the river adjacent to the hatchery during a 12,000 cfs flood with the Federally Preferred Plan. In general, the lowest ground at the hatchery is at elevation 666. When a 12,000 cfs flood event occurs, the tailwater elevation is estimated at 667. The existing drainage for the site will result in water backing up and minor flooding (1-foot-deep) occurring around the fish hatchery clarifier. If this is unacceptable then the drainage culvert could be plugged and the area drained with a diaphragm (trash) pump over the westerly road. Regardless, this evaluation assumes a groundwater elevation on the hatchery side at 667 to calculate seepage.

Figure 4-4 "Flooding Concerns Sections" depicts levee cross sections at 250 feet and 500 feet upstream of the diversion. Note that the topography results in a relatively wide bank north of the proposed levee. The various water surface elevations are depicted along with existing grade and the proposed levee. The geological conditions are based on the geotechnical report, by GeoEngineers dated May 1992. The geological cross section assumes a conservatively thick alluvial layer and the permeability is selected from the high end of the estimated range at 4.4×10^{-2} cm/sec. Seepage is estimated to occur along a 200-foot-length of the bank just south of the clarifier. The thickness through which seepage will occur is estimated at 20 feet, and the hydraulic grade is the difference in water surfaces over the length of the flow path (see the flow net and calculations depicted on Section B) Based on these assumptions the seepage rate is calculated as Q (flow) = K(permeability) x A(Area) x I(Hydraulic Grade):

Q = 0.044(cm/s) x (1-ft / 30.48-cm) x 20 ft x 200 ft x 0.079 ft/ft, therefore Q = 0.46 cfs

The hydraulic grade for the Locally Preferred Plan is 0.054. Since seepage is proportional to the hydraulic grade, the seepage estimated for the Locally Preferred Plan is Q =0.31 cfs (0.46 cfs x 0.054/0.079).

This level of seepage does not represent a significant problem and would only affect the area around the clarifier. If minor flooding, which would occur due to drainage backwater could be tolerated, then the seepage would drain to this level and flow downstream. If the drainage culvert were plugged, then the area could be drained with a portable diaphragm (trash) pumping over the westerly road. Regardless of how seepage is handled, there is relatively little difference between the two plans.

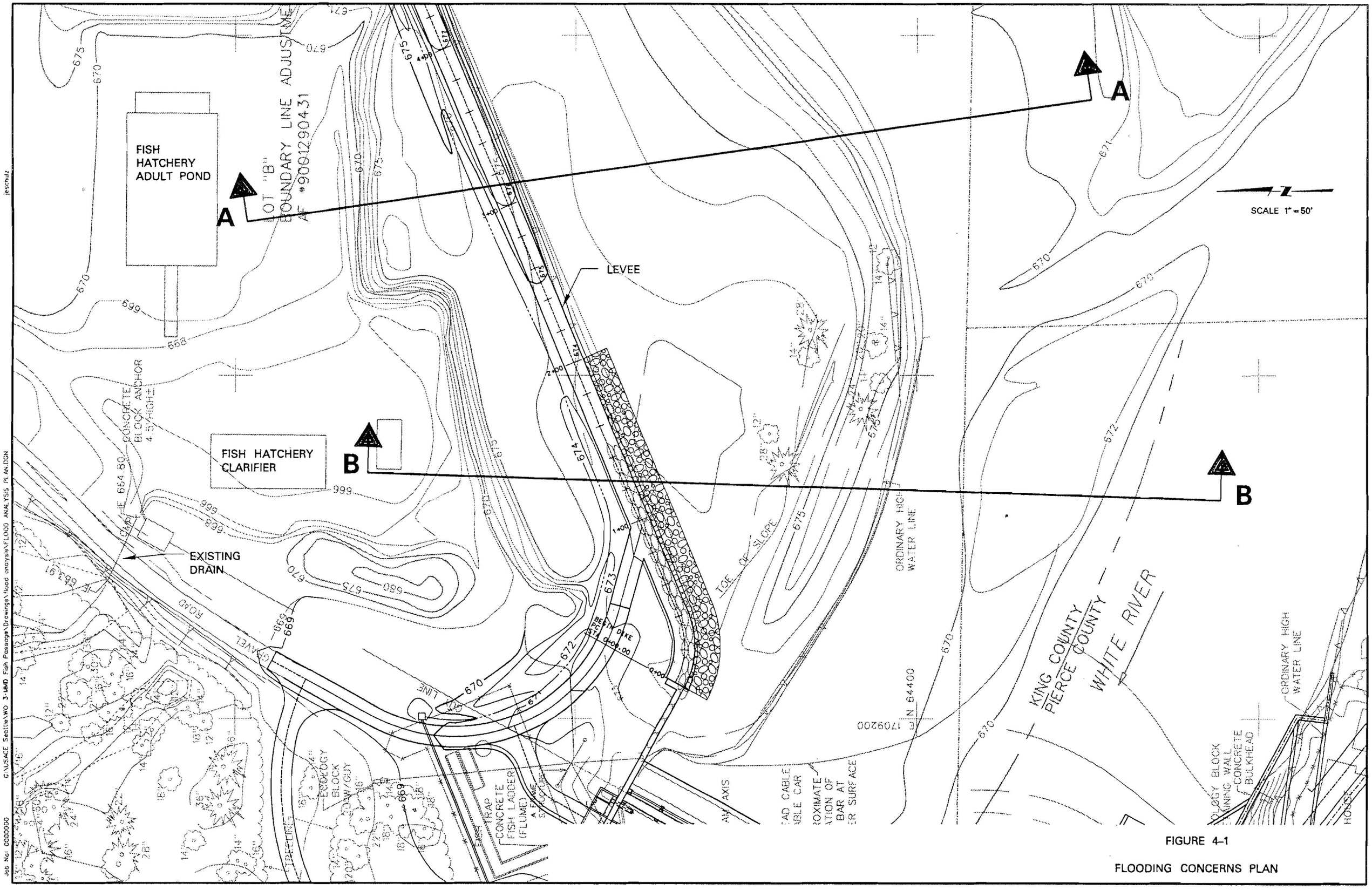
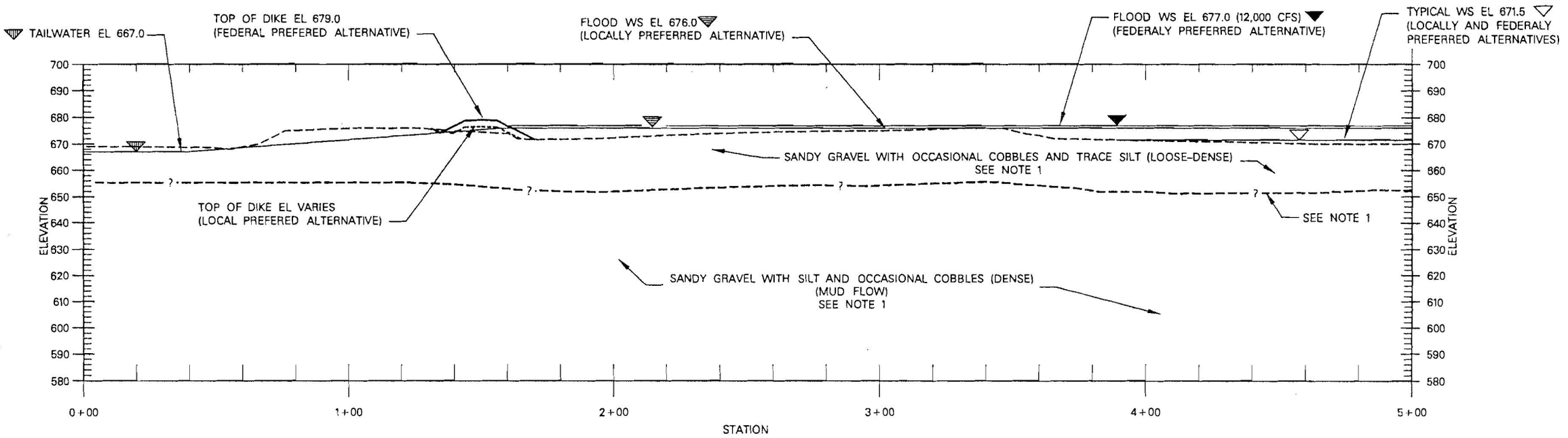


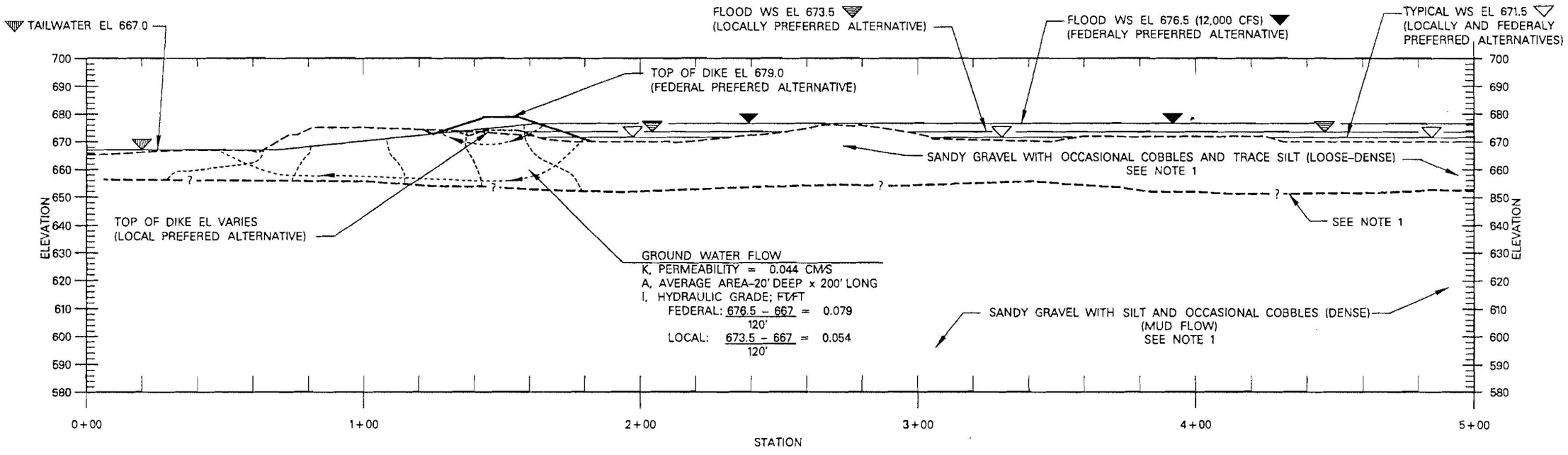
FIGURE 4–1

FLOODING CONCERNS PLAN

Figure 4-3 Flooding Concerns Plan



SECTION A – A
(500 FT UPSTREAM OF DIVERSION)
SCALE: 1"=40' HORIZONTAL



SECTION B – B
(250 FT UPSTREAM OF DIVERSION)
SCALE: 1"=40' HORIZONTAL

NOTES

1 SOURCE T.M. NO. 16 – GEOTECHNICAL REPORT, GEOENGINEERS, MAY 1992.

FIGURE 4-2
FLOODING CONCERNS SECTIONS

Plot Date: 11/12/2003
User: jescruz
File: G:\USACE Seattle\WO 3-HMO Fish Passage\Drawings\flood analysis\FLOOD ANALYSIS SECTIONS.dgn
Job No: 0000000

Figure 4-4 Flooding Concerns Sections

4.2.8 Minimize Capitol Cost

The Federally Preferred Plan is less costly.

4.2.9 Minimize Operation and Maintenance Cost

The Federally Preferred Plan is less costly, with fewer mechanical features.

4.2.10 Minimize impacts on aquatic environment

The Federally Preferred Plan will require more in-water-work and a longer construction duration resulting from the need of 3 cofferdams rather than the 2 required to construct the Locally Preferred Plan.

4.2.11 Minimize impacts on adjacent terrestrial habitat

The Federally Preferred Plan in general disturbs less area on the left bank side of the river, however the larger right bank levee will impact slightly more area than on the left bank side.

4.2.12 Minimize impacts on upstream and downstream migrants

Both alternatives have similar impacts to upstream migratory fish, since they employ an identical fish trap. The flow conditions will vary between the plans as a result of the diversion, which may influence upstream passage. Both alternatives have similar effects on downstream migrants. Any fish entrained in the water diverted from the PSE flume will encounter PSE White River Fish Screens.

4.2.13 Regulation Compliance

There is no difference in regulatory compliance between the Federally Preferred Plan and Locally Preferred Plan.

4.3 REAL ESTATE CONDITIONS

4.3.1 General

The following describes the feasibility level real estate requirements for the federally preferred plan. The feasibility level real estate plan documented below is used for USACE planning purposes to support project cost estimates for project approval and authorization. Refinements to the real estate plan will be made following finalization of the project design, approval of any non-standard estates, an acquisition appraisal and other pre-acquisition activities.

A gross appraisal report was completed for the use of the USACE in the planning of the Mud Mountain Dam - Fish Passage Barrier Project. The purpose of this appraisal is to estimate the market value for approximately 3.63 acres of land and barrier structure owned by PSE, the market value for access, levee and permanent flowage easements (including single family residence and garages) over approximately 22.17 acres of land owned by PSE, and the estimated market rent for a temporary construction easement over approximately 5.61 acres of land owned by PSE. Also estimated is the market value for a permanent flowage easement over approximately 2.75 acres of land owned by Washington State-Social and Health Services. The gross appraisal included market value estimates for the takings in a before and after format as well as estimates of special benefits. The

appraisal concludes no damages to the remainders of the ownerships. Benefits were estimated to more than offset the taking for the Puget Sound ownership.

4.3.2 Summary of Appraisal Problem

The proposed project is approximately 32.56 acres (net) of land and improvements located on the White River near Buckley, Washington. Note attached Real Estate Map-Plate 24 (in Volume 2). Most of the proposed project is a portion of a much larger existing canal and reservoir system (known as Lake Tapps) owned by PSE. Improvements included in the gross appraisal estimate are the barrier structure and a single family home with garages all owned by PSE.

The proposed project includes acquiring from PSE 3.23 acres in fee with improvements (including barrier structure), 0.40 acres in fee subject to existing Army Corp of Engineers easement, 5.70 acres in permanent road easements, 0.08 acres in a permanent bridge easement, 1.05 acres in a levee easement, 15.34 acres in a permanent flowage easement (including dwelling and garages), and 5.61 acres in a temporary construction easement for a 24-month period (all acreages are approximate). Also to be acquired from the State of Washington-Social and Health Services is approximately 2.75 acres as part of the permanent flowage easement.

There are three other possible ownerships involved as shown on the attached real estate map. These have not been firmly established and require more research. They are included for reference as possible ownership discrepancies with existing owners. These potential discrepancies involve King County as a public entity and two private ownerships. Based on available information, these possible discrepancies are covered by a contingency in case they prove to be valid.

Also noted is a possible transfer of PSE holdings to the Muckleshoot Tribe located adjacent to and around the north side of the barrier structure. This transfer is currently under way but has not been completed and recorded as of this writing. If this transfer is completed and recorded before acquisition, then the Muckleshoot Tribe would be another land owner involved in the acquisition process. The addition of Tribal ownership will impact real estate acquisition as noted in the Real Estate Plan.

4.3.3 Relocation

Acquisition of the PSE ownership would include the relocation of one tenant and family currently living in the dwelling owned by PSE. This tenant is an employee of PSE. The estimated relocation costs of $125,000 are based on the maximum benefits available to a tenant under PL 91-646. Actual costs are to be determined at the time of the relocation study referenced in the Real Estate Plan.

4.3.4 Legal Description

The proposed project is located in Section 35, T20N, R6E, Willamette Meridian, King County, Washington, and Section 02, T19N, R6E, Willamette Meridian, Pierce County, Washington, near the town of Buckley, Washington.

4.3.5 Special Benefits

The proposed acquisition involves significant special benefits to the remainder of the PSE ownership. The water right owned by PSE is not being acquired. It remains essentially the same, both before and after acquisition of fee simple and easement rights acquired.

The main difference between the before and after value conditions is that a new barrier structure is in place in the after condition that will include a perpetual agreement for operation and maintenance of the new barrier structure at no cost to PSE or future owners. Also in place in the after condition will be an agreement with PSE (and to future owners) that insures that the delivery of the water right will not be interfered with. The replacement of the barrier structure, including the operation and maintenance agreement at no cost to PSE and the agreement insuring the delivery of PSE's water right, significantly reduces the cost and risk of ownership of the remainder of the PSE ownership and enhances or increases the remainder's market value. The fee and easement rights being acquired are small in relation to the large increase in value of the remainder, therefore, there is considerable special benefit to the remainder of the PSE ownership that offsets the value of the fee simple and easement rights being acquired.

4.3.6 Lands, Easements & Rights of Way (LER)

The following is a summary of the ownerships and estates and the estimated market value by each estate proposed for implementing the project:

PSE:

Fee with improvements (barrier structure)	3.23 acs	$893,100
Fee subject to existing ACOE easement	0.40 acs	$20
Permanent road and bridge easements	5.78 acs	$52,100
Permanent right bank levee easement	1.05 acs	$1,000
Permanent flowage easement	15.34 acs	$66,350
Dwelling and garages as part of flowage easement		$37,500
Temporary construction easement	5.61 acs	$7,500
Sub Total	31.41 acs	$1,057,570

Estimated Market Value	$1,057,570
Estimated Damages	$0
Estimated Special Benefits	$11,300,000
Estimated Market Value After Offsetting Benefits	**$0**

Washington State – Social and Health Services:

Permanent flowage easement	2.75 acs	$14,658

Estimated Market Value	$14,658
Estimated Damages	$0
Estimated Special Benefits	$0
Estimated Market Value After Damages/Benefits	**$14,658**
Rounded	**$15,000**

Total acres and Estimated Market Value After Offsetting Benefits	**34.16 acs**	**$15,000**

4.3.7 Real Estate Cost Summary

Lands and Damages		$ 15,000
Relocation Benefits		$125,000
Other Possible Lands & Damages		$133,000
Federal Acquisition Costs		$390,000
Subtotal		$663,000
Contingency (15%)		$ 99,000
	Total	**$762,000**

4.4 Cost Allocation & Cost Sharing of Federally Preferred Plan

4.4.1 Overview

The following is provided as background information in determining the cost sharing requirements of this project.

Mud Mountain Dam was constructed in 1938 at 100 percent federal cost. A mitigation requirement of the Mud Mountain Dam (MMD) construction was to provide upstream fish passage for anadromous fish. This was accomplished by constructing fish collection and transport facilities (trap-and-haul) in 1948 at an existing privately owned barrier/diversion structure. The facilities are used to trap salmon and steelhead which are collected and placed in a truck, transported around MMD, and then released in the river approximately 5 miles above the dam. This diversion structure was initially used solely to impound sufficient storage so that water could be diverted from the White River via flume to be used for generating electricity at a hydroelectric power plant located downstream of Lake Tapps. It is important to note that since implementation of the fish collection facility as mitigation for the construction of MMD, Puget Sound Chinook salmon and Bull Trout have been listed as a threatened species under the ESA. These are salmonids found in the White River and the listing necessitates action on the part of the USACE because of the impacts of the existing MMD project. In other words, not only is there a USACE mitigation requirement to provide upstream fish passage around MMD, but there is also a legal requirement under the ESA to continue to provide an acceptable way for upstream fish passage. Federally Preferred Plan

4.4.2 General

Seven fish collection and transport alternatives at different locations were considered and evaluated in this study. Three were at the existing site, three were at a gaging station located 1.5 miles downstream of MMD, and two near the downstream toe of MMD. The study determined that replacement at the existing site provides the highest probability of successful fish passage at a cost similar to other alternatives and as such is considered the most cost effective environmentally acceptable upstream fish passage alternative. It is also expected to be the most cost effective alternative to satisfy ESA requirements for upstream fish passage. The federal plan addresses the USACE's responsibility to provide fish passage but not preclude nor improve the existing ability for water diversion and is described in detail in Section 4, Plan Selection. Given the 2,000 cfs water right of the hydroelectric plant owner, any design that would reduce or eliminate the ability to divert water to the hydroelectric plant would be considered a taking for which the USACE would need to reimburse the owner of the hydroelectric facility. Major components of this plan consist of improving the existing fish collection facility by installing a new 130 cfs supply intake with fish screens, screen cleaner and sediment control pump, a 70 cfs auxiliary

attraction water supply with upstream control gates, a new fish ladder entrance with an entrance slot and entrance channel, replacement of the existing flashboard system with a ogee shaped concrete weir, and the installation of 16-foot and 35-foot radial gates which are used to remobilize bed load and debris that accumulates in front of the fish screen intake. The capital cost of this plan is estimated at $17,088,000.

Operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs of the new fish passage facilities consist of OMRR&R for the fish trap as well as for the diversion dam. An itemized list of these costs can be found in Mud Mountain Dam Decision Document, Table 4-3, Federally Preferred Plan, Operation and Maintenance Costs, 50-Year Life Cycle. The total present value of OMRR&R costs is estimated at $3,896,000.

4.4.3 Cost Sharing

Mud Mountain Dam was authorized by the Flood Control Act of 22 June 1936, 74th Congress, second session. There is no mention of a local sponsor or local interest responsibility to the project. Other than a 1948 agreement with PSE and the State of Washington providing access and operation parameters for the fish trap, there are no contracts or other type of agreements with non-federal entities regarding the construction of the original project or fish passage facility. There is an existing right to divert 2,000 cfs from the White River to supply water to the hydroelectric facility. Without an existing non-federal sponsor for the original project or other contracts in place pertaining to the original project, there are no non-federal responsibilities for ESA or mitigation pertaining to the original construction of the dam. As a result, cost sharing of the federally preferred plan is based on the fact that only the USACE has a legal obligation to provide fish passage around MMD to meet mitigation and ESA requirement for MMD. In other words, the Federally Preferred Plan is considered a continuation of the USACE's mitigation (and ESA) requirement for a single-purpose flood control project originally paid for by the federal government. While the biological opinion for this project has not yet been issued, it is expected it will approve the USACE plan to construct the recommended federally preferred fish passage.

Finally, without this project the diversion structure and ultimately the fish collection facility will fail which will in turn result in the USACE having to construct exactly the type of project that is recommended to meet the continuing mitigation and/or ESA requirements for MMD.

4.4.4 Conclusion

The basis for allocating federal cost responsibility is the cost of the Federally Preferred Plan. This plan best meets the federal government's objectives for fish passage around the MMD without unduly restricting other uses at the site. The cost of any features in the Locally Preferred Plan that go beyond the federal government's objectives for fish passage would be allocated to the Local Sponsor as betterments solely to the diversion characteristics of the diversion dam.

4.4.4.1 Federally Preferred Plan: Given the USACE's continuing responsibility to provide mitigation (i.e. upstream fish passage) for the construction of MMD as well as to meet the expected ESA requirements, all construction costs as well as OMRR&R costs for the federally preferred fish passage facilities is considered to be a federal cost and paid 100 percent by the federal government. As shown above, the construction cost of this project is estimated to be

$17,088,000 and the total present value OMRR&R cost is estimated to be $3,896,000

4.4.4.2 Locally Preferred Plan: As presented in Section 4.1.3, there is also a locally preferred plan, which provides fish passage but also improves the projects ability to divert water from the White River. The federally preferred plan is considered to be the most cost effective plan to provide upstream fish passage. The locally preferred plan is considered to be a betterment compared to the federally preferred plan. The locally preferred plan has a construction cost of $20,006,000 and a total present value OMRR&R cost of $4,965,000. Since this project s considered to be betterment, any cost that exceeds the federally preferred plan is considered to be a local sponsor responsibility. Following technical review of both plans the prospective sponsor, Pierce County, withdrew support for the locally preferred plan. Should the locally preferred plan be constructed instead of the federally preferred plan, the local sponsor construction cost share would be an estimated $2,918,000 ($20,006,000 - $17,088,000). The sponsor's share of OMRR&R cost would be $1,069,000. ($4,965,000 - $3,896,000).

SECTION 5 -- Conclusions and Recommendation

5.1 GENERAL

The Federally Preferred Plan is a simpler, less costly, facility than the Locally Preferred Plan. The Federally Preferred Plan provides the least-cost environmentally acceptable solution to long-term safe and efficient fish passage at Mud Mountain Dam. This plan will allow for the existing diversion to remain in operation, however, excluding bedload from the diversion will not be achieved as well as with the Locally Preferred Plan. The Federally Preferred Plan will provide better bedload management than the existing facility. The Federally Preferred Plan will result in higher headwater conditions during extreme flow events, but this can be effectively managed by levee improvements.

5.2 ENVIRONMENTAL AND REGULATORY

< Refer to Appendix B Environmental >

5.3 IMPLEMENTATION

5.3.1 General

During the Independent Technical Review (ITR) and Value Engineering (VE) sessions which took place following the submittal of the draft 35% decision document, promising new ideas and modifications to the existing schemes were discussed. These ideas are presented here with the understanding that they will provide a roadmap for the 65% design effort.

5.3.2 Maintenance Deck

Designs for both the FPA and the LPA have not included maintenance access decks capable of supporting truck and crane traffic. To facilitate dewatering and debris management, maintenance decks are to be included for both alternatives. Figures 5-1 and 5-2, 5-3 and 5-4 depict maintenance decks for the locally and federally preferred plans. (It is important to note that these decks are not shown on any other plates included in this document.) Costs for the maintenance decks have been developed using MCASES. These costs are included in Tables 4-2 and 4-5. The maintenance deck and costs will be refined at the 65% design level.

5.3.2.1 Maintenance Deck Details: The maintenance deck details are similar for both the FPA and the LPA. Both options include a maintenance deck that spans the entire length of the dam structure. Both options include access from either bank. The elevation of the bottom chord was set to allow passage of flood flows and debris that would accompany the maximum Mud Mountain Dam discharge of 24,800 cfs. Both options require that the existing man-basket trolley system be demolished. The bridge and access ramp designs will be refined at the 65% design level.

5.3.2.2 Dewatering: The previous dewatering scheme envisioned placement of stoplogs through access along the upstream apron. Stanchions would be placed in the stoplog pockets and stoplogs would be dropped into place. Because the stoplog pockets would likely fill with sediment and cobbles, this scheme is considered too difficult to maintain. Inclusion of the maintenance decks for both the FPA and LPA will allow dewatering to be accomplished from the

TEMPORARY CONSTRUCTION EASEMENT

PROJECT PROPERTY LIMITS

WHITE RIVER

TOE OF SLOPE

TEMPORARY DIVERSION CHANNEL

T.O.W. EL 675.5

EXCLUDER WALL T.O.W. EL 666.4

TEMPORARY DIVERSION GATES

DIVERSION INTAKE CHANNEL

EXISTING DIVERSION GATES

DIVIDER WALL T.O.W. EL 674.0

UPSTREAM LIMIT OF EXISTING BARRIER

FISH SCREEN FACILITIES

16' RADIAL GATE

35' RADIAL GATE

RIGHT BANK LEVEE, 60' WIDE EASEMENT

4% UP

9.1% DOWN

12.8% UP

HATCHERY FISHWAY AWS

FIXED CREST WEIR, TYP

RUBBER WEIRS

FISH TRAP LADDER

PSE DIVERSION FLUME

HOLDING POOL

LOADING POOL

HATCHERY FISHTRAP

JIB CRANE

HATCHERY FISHWAY

BARRIER APRON

DOWNSTREAM LIMITS OF EXISTING BARRIER

HATCHERY FISHWAY ENTRANCE

BYPASS RAMP GATE

FISH TRAP ENTRANCE

CONTROL BUILDING

NOTE:

MAINTENANCE BRIDGE DECK AND ACCESS ROADS SHOWN HERE DO NOT APPEAR ON ANY OTHER PLATES ASSOCIATED WITH THIS DOCUMENT. OTHER PLATES WILL BE UPDATED AT 65% DESIGN LEVEL.

OVERALL SITE PLAN

SCALE: 1"=50'

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

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CORPS OF ENGINEERS
SEATTLE, WASHINGTON

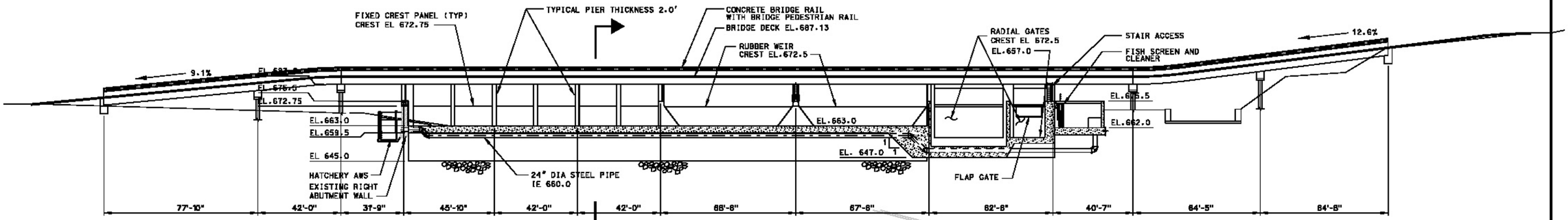
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
PROPOSED MAINTENANCE BRIDGE DECK

SIZE	INVITATION NO.	FILE NO.	FIGURE
B	—		5-1

DSGN: M.H.H. | CHK: D.E.D. | SHEET 1 OF 4

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\Bridge_Study\Bridgeplate501.dgn 30-MAR-2005 08:22



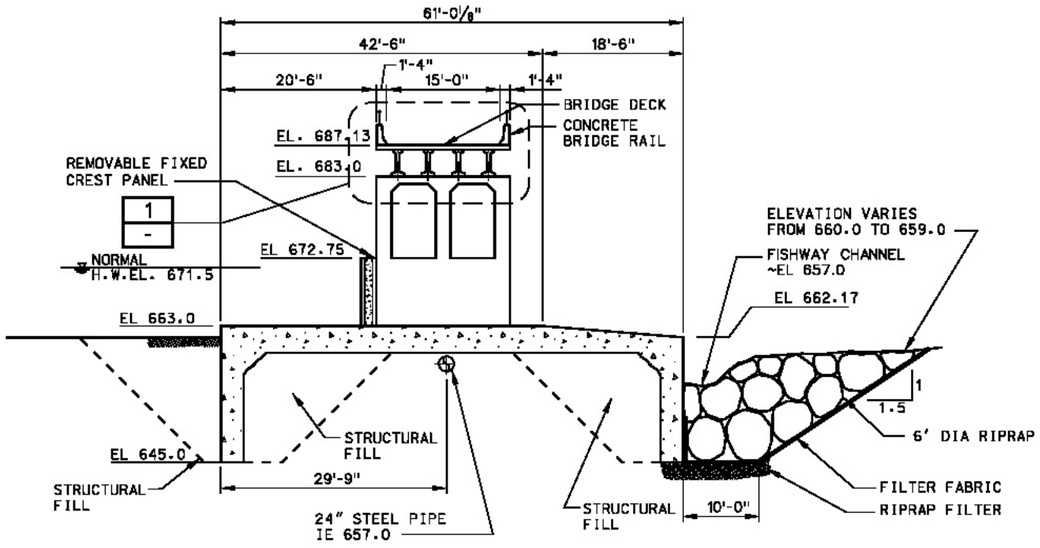
A

DAM ELEVATION

SCALE: 1" = 50'

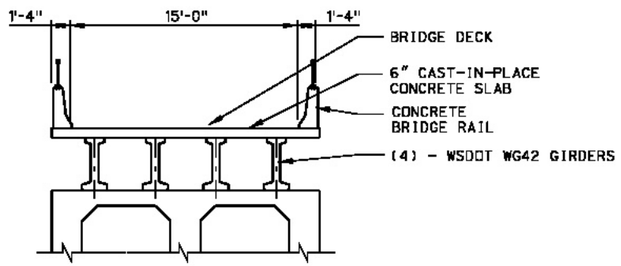
NOTE:

MAINTENANCE BRIDGE DECK AND ACCESS ROADS SHOWN HERE DO NOT APPEAR ON ANY OTHER PLATES ASSOCIATED WITH THIS DOCUMENT. OTHER PLATES WILL BE UPDATED AT 65% DESIGN LEVEL.



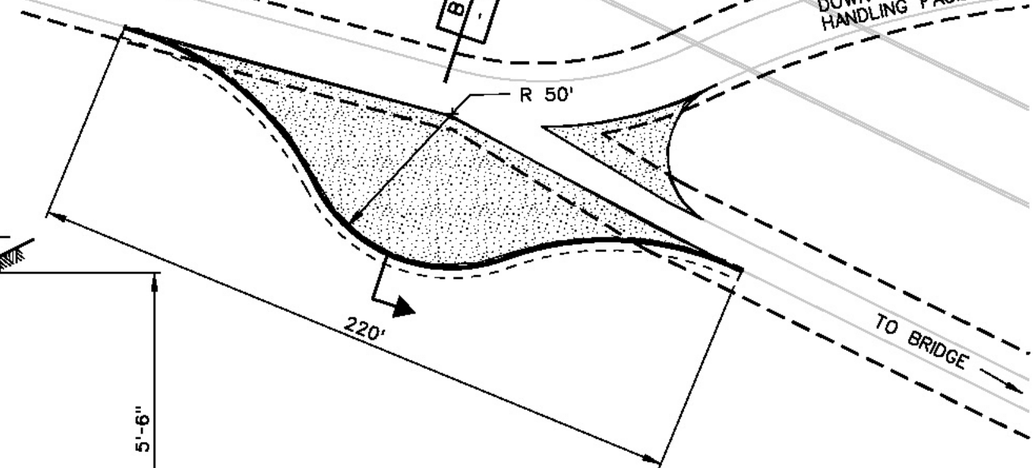
SECTION A

SCALE: 1" = 20'



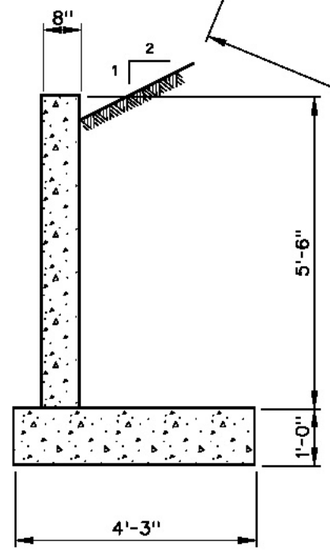
DETAIL 1

SCALE: 1" = 10'



TURNAROUND IMPROVEMENT PLAN

SCALE: 1"=50'



SECTION B

SCALE: ⅜" = 1'-0"

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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
PROPOSED MAINTENANCE BRIDGE DECK

SIZE	INVITATION NO.	FILE NO.	FIGURE
B	—		5-2

DSGN: M.H.H. | CHK: D.E.D. | SHEET 2 OF 4

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\Bridge_Study\Bridgeplate502.dgn 30-MAR-2005 08:23

TEMPORARY CONSTRUCTION EASEMENT

PROJECT PROPERTY LIMITS

WHITE RIVER

DIVERSION OPTION NOT SHOWN SEE PLATES

EXISTING DIVERSION GATES

DIVIDER WALL T.O.W. EL 674.0

UPSTREAM LIMIT OF EXISTING BARRIER

FISH SCREEN FACILITIES

16' RADIAL GATE

RIGHT BANK LEVEE, 60' WIDE EASEMENT

HATCHERY FISHWAY AWS

FIXED CREST WEIR, TYP

RUBBER WEIRS

FISH TRAP LADDER

PSE DIVERSION FLUME

HOLDING POOL

LOADING POOL

HATCHERY FISHTRAP

JIB CRANE

HATCHERY FISHWAY

BARRIER APRON

DOWNSTREAM LIMITS OF EXISTING BARRIER

HATCHERY FISHWAY ENTRANCE

BYPASS RAMP GATE

FISH TRAP ENTRANCE

CONTROL BUILDING

NOTE:

MAINTENANCE BRIDGE DECK AND ACCESS ROADS SHOWN HERE DO NOT APPEAR ON ANY OTHER PLATES ASSOCIATED WITH THIS DOCUMENT. OTHER PLATES WILL BE UPDATED AT 65% DESIGN LEVEL.

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

OVERALL SITE PLAN

SCALE: 1"=50'

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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE

PROPOSED MAINTENANCE BRIDGE DECK

SIZE	INVITATION NO.	FILE NO.	FIGURE
B	—		5-3

DSGN: M.H.H. | CHK: D.E.D. | SHEET 3 OF 4

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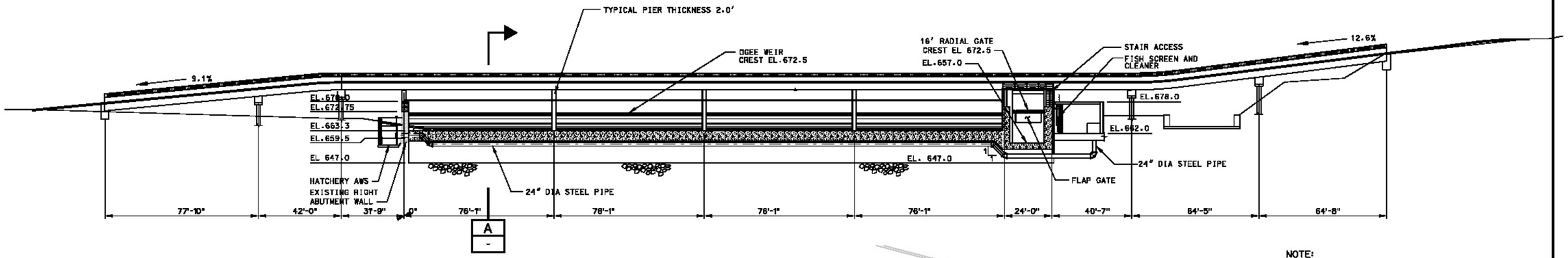
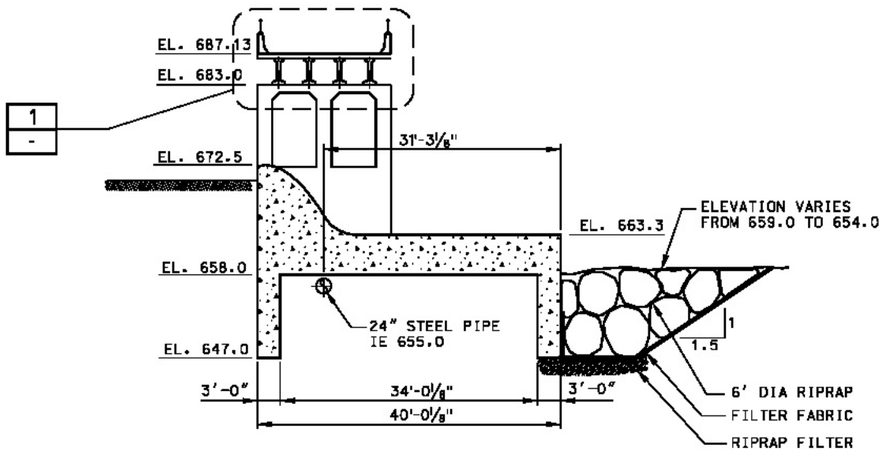


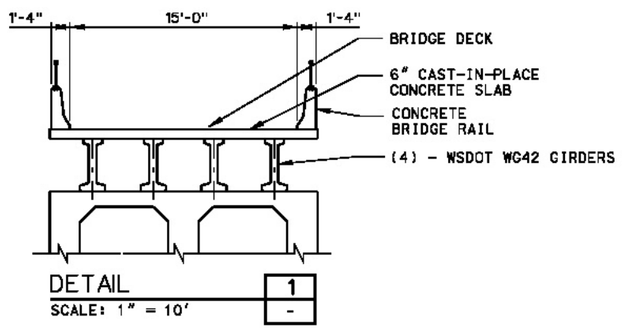
DAM ELEVATION
SCALE: 1" = 50'

NOTE:

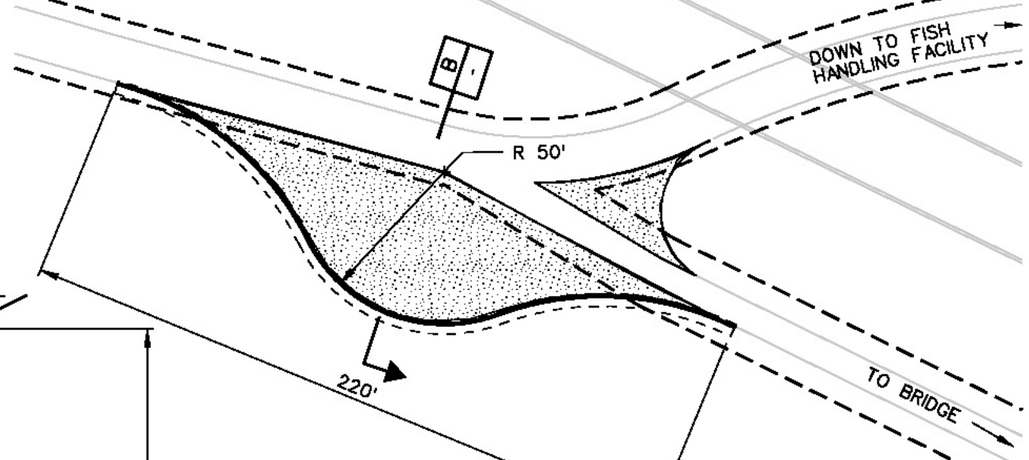
MAINTENANCE BRIDGE DECK AND ACCESS ROADS SHOWN HERE DO NOT APPEAR ON ANY OTHER PLATES ASSOCIATED WITH THIS DOCUMENT. OTHER PLATES WILL BE UPDATED AT 65% DESIGN LEVEL.



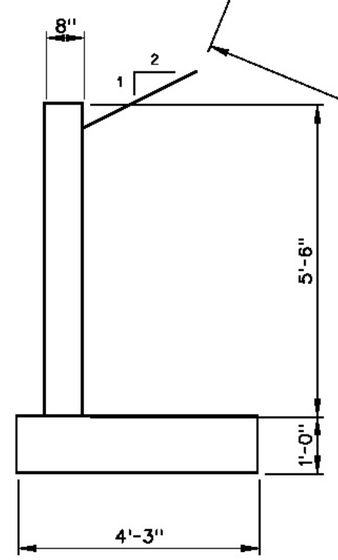
SECTION A
SCALE: 1" = 20'



DETAIL 1
SCALE: 1" = 10'



TURNAROUND IMPROVEMENT PLAN
SCALE: 1"=50'



SECTION B
SCALE: ⅜" = 1'-0"

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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
PROPOSED MAINTENANCE BRIDGE DECK

SIZE	INVITATION NO.	FILE NO.	FIGURE
B	—		5-4
DSGN: M.H.H.	CHK: D.E.D.	SHEET 4 OF 4	

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\Bridge_Study\Bridgeplate504.dgn 30-MAR-2005 08:25

bridge deck. Steel stoplogs spanning the full width of the gates can be lowered into place from the maintenance deck. The dewatering scheme will be refined at the 65% design level.

5.3.2.3 Debris Management: The previous debris management scheme envisioned access to the debris by driving out on the upstream and downstream aprons with a boom truck and a dump truck. Debris would be loaded and removed. Inclusion of the maintenance decks for both the FPA and LPA will allow a crane to reach debris from the deck. It could then be either lifted from the upstream side and placed on the downstream side, or loaded on a truck for off-site disposal.

5.3.2.4 Turnaround Improvement: The turnaround improvement will allow the use of the existing bridge by truck traffic traveling to the fish handling facility from the maintenance deck. Access from either bank will be provided for the both the FPA and the LPA. However, left bank access poses difficulties for both alternatives. Site limitations do not allow direct access to the parking area downstream of the fish facilities on the left bank. The design of the left bank access ramp envisions crossing the PSE flume and landing at the upper terrace near elevation 710. Rather than build a second bridge back across the flume immediately downstream of the fish handling facilities, the design relys on an existing bridge over the canal located approximately 1500 feet downstream from the fish handling facility. The turn from the access road on to the bridge is too sharp for trucks to negotiate in its present configuration. Consequently, a retaining wall will be built near the existing bridge. The retaining wall will allow construction of a turnaround with a radius of 50 feet.

5.3.3 Shortened Dam Structures

It may be possible to shorten the dam in both the FPA and the LPA. The existing dam is located in a wider reach of the river than reaches found upstream or downstream. The hydraulics of a shortened dam will be studied at the 65% design level to ensure that flood protection is provided to an acceptable level.

A shortened dam could simplify construction. A cofferdam could be constructed that would allow construction of all the left bank (LB) fish facility improvements, the tainter gates, and the right abutment behind one cofferdam. The right abutment would include a new fishway entrance and water supply. Under this scenario, the river would be diverted to the right bank (RB) during the first phase of construction. The RB fish facilities would be upgraded to accommodate all the upstream migrants while the LB facility was under construction. Following completion of the LB improvements, the cofferdam would be reconfigured to protect the RB while construction proceeded on a non-overflow earth section that would tie the right abutment to the RB.

The shortened dam concept envisions the delivery of attraction flow for the RB fishway entrance from a screened intake located on the upstream portion of the right abutment. The screened intake would replace the 24-inch auxiliary water supply shown below the dam in the drawings. The screen would sized for twice the design flow required. This will be done because the screen will be cleaned by hand if required. No mechanical screen cleaner is contemplated for this option. A fishway would extend from the right abutment to the RB fish handling facilities.

The following items will also be considered at the 65% design level:

- Lowering the elevation of the apron on the downstream side of the dam for both the FPA and LPA will be considered due to concerns about adult fish strandings.
- Flow and deposition patterns below the gates will be examined to ensure acceptable conditions at the fishway entrance.
- For the LPA, a shortened dam may require an additional tainter gate to pass the flood flow.
- An additional small tainter gate will be needed to regulate instream flows. (see Section 5.3.4)
- A minimum gate opening of 0.8 feet will be maintained.
- The tainter gates will be enlarged so crests extend 1.5 feet higher.
- The small flapgate for passing debris will be eliminated.
- Because a certain level of discomfort was expressed by the USACE as to the longevity of the rubber weirs and the longevity of the rubber weir manufacturers, the use of rubber weirs for the LPA will be reconsidered.

5.3.4 Left bank Water Intake Improvements

In the existing design, the fish bypass ramp gate doubles as the instream flow regulator. Up to a certain flow, all water passes through the bypass. When the flow increases beyond a certain amount, a tainter gate must be opened at the same time that the fish bypass ramp gate is closed. As flow increases through the bypass system, hydraulic conditions deteriorate at the screens. Hence, a new scheme will be developed at the 65% design level.

The key feature of the new scheme is to maintain a constant flow through the bypass. Approximately 125 cfs will be diverted; 35 cfs for the trap and ladder flow; 70 cfs for fishway entrance attraction flow; and 20 cfs for fish screen bypass flow. This will allow optimization of the screen hydraulics and simplification of the bypass ramp gate. Because the rampgate will no longer regulate the instream flow, it can be modified such that only a small articulating section is required. This articulating section will maintain a constant bypass flow of 20 cfs. Instream flow will be regulated through an additional tainter gate.

Other items to be considered at the 65% design level include:

- Consideration of sediment deposition around the fish way entrance will be examined in more detail.
- A suitable location for the fish return flume from the trap to the tailrace will investigated.
- More openings in the PSE diversion intake walls will be made to improve approach flow conditions to the screens.

5.3.5 Left bank Fish Handling Facility Improvements

Consideration of the following changes to the LB fish handling facilities to be evaluated at the 65% design level include:

- A roof structure over the fish handling facility
- Changing stainless steel brail to wood.

- Addition of fish crowding and lifting facilities.
- Addition of sorting facilities.
- Consideration of optimum flume location to return some fish directly from the trap facility back to the river.

5.3.6 Right bank Fish Handling Facility Improvements

During the ITR process, an issue was raised as to whether the proposed conduit on the left bank would be sufficient to attract fish during construction. As an alternative, a proposal was developed to make improvements to the right bank hatchery intake and to use it to collect fish during the project construction.

Figure 5-5 shows a conceptual design for an improved right bank fish handling facility. Its main features include:

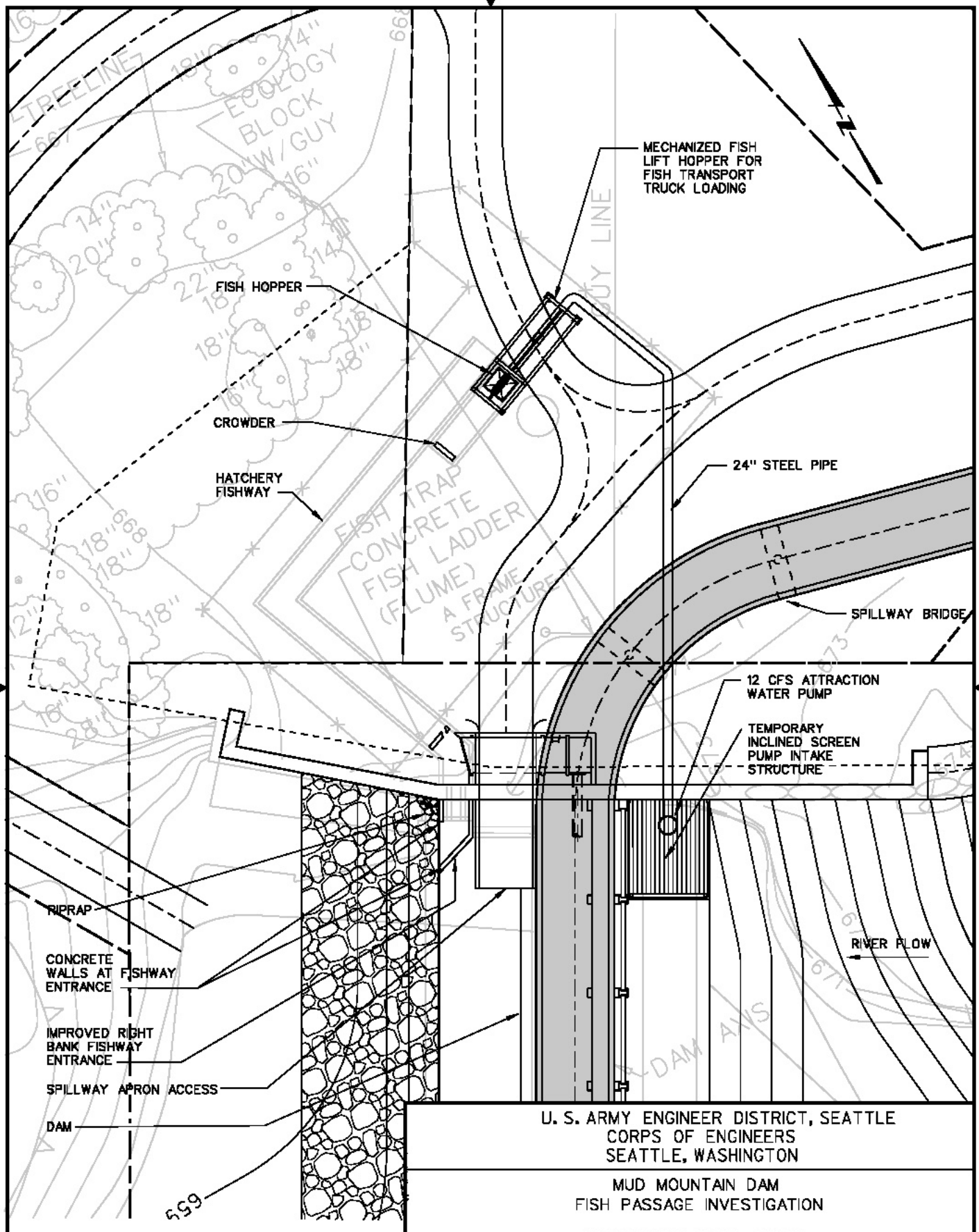
- A reoriented fishway entrance
- Mechanized fish lift hopper for fish transport truck loading.
- Fish transport truck loading facility.
- Pumped add-in water supply to ladder for improved fishway attraction flows.

A more detailed design with costs will be developed at the 65% level.

5.3.7 Other Issues

5.3.7.1 Operations and Maintenance Responsibilities: It is anticipated that the USACE wold be the responsible entity for operating and maintaining the new barrier structure in addition to operation and maintenance responsibilities related of to the trap-and-haul facility. PSE or the current owner of the intake would be responsible for all associated expenses related to maintaining a diversion to Lake Tapps. An operating agreement between the USACE and PSE is anticipated to outline specific operational parameters to protect both parties' interests. Any such agreement would be developed in conjunction with real estate acquistion.

5.3.7.2 Effect of Tacoma Pipeline Removal: The HEC-6 analysis of the effect of removing the Tacoma Pipeline detailed in Appendix C indicates that the tailwater curve at the barrier dam could be affected in the course of a few years. Lowering of the tailwater will not reduce the effectiveness of the fish barrier, but it could affect the entrance to the fish ladder. This possibility will be examined at the 65% design level.



U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

PROPOSED RIGHT BANK HATCHERY IMPROVEMENTS

SCALE: 1"=30'

MWH

SIZE	INVITATION NO.	FILE NO.	FIGURE
B	—		5-5

DSGN: M.H.H.	CHK: D.E.D.	SHEET 1 OF 4

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\Bridge_Study\Bridgeplate505.dgn MAR-2005 08:26

US Army Corps
of Engineers
Seattle District

Draft

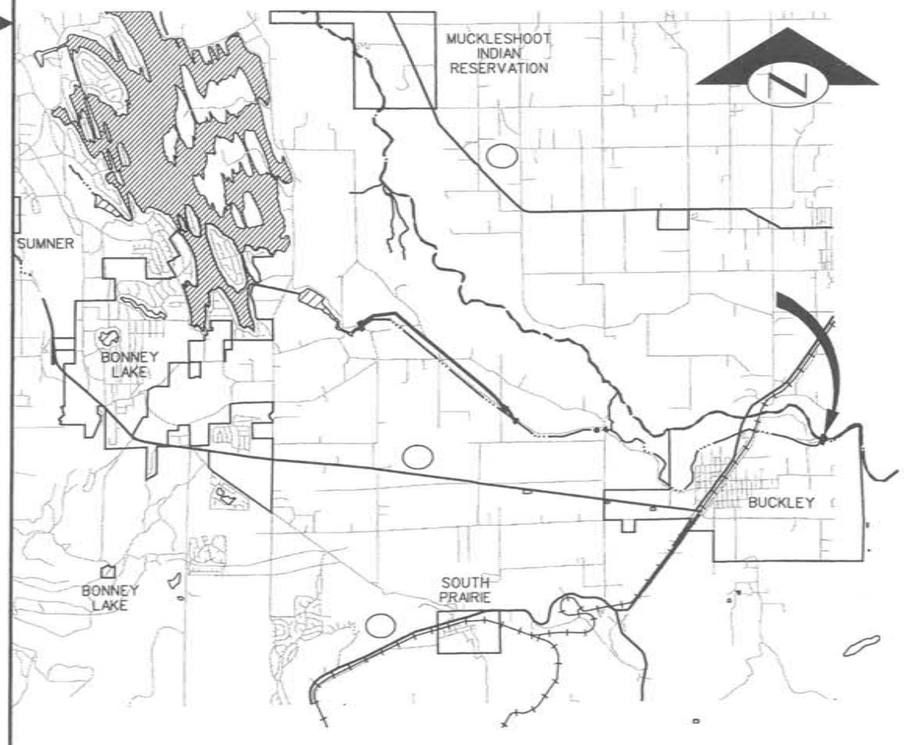
Mud Mountain Upstream Fish Passage Investigation

Volume 2 – Plates

Supplement Number 3 to Feature Design Memorandum Number 28, to Dam Safety Assurance Program, Mud Mountain Dam, White River, Washington

March 2005

LOCATION MAP



U.S. ARMY ENGINEERS DISTRICT, SEATTLE
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MUD MOUNTAIN DAM FISH PASSAGE INVESTIGATION

JANUARY 2005

LIST OF PLATES

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCATION MAP, VICINITY MAP AND LIST OF PLATES

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		1
DSGN: F.E.P.	CHK: D.E.D.	SHEET 1 OF 41	

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate01.dgnDATE AND TIME PLOTTED: 03-JAN-2005 10:29

TEMPORARY CONSTRUCTION EASEMENT

PROJECT PROPERTY LIMITS

WHITE RIVER

TEMPORARY DIVERSION CHANNEL

T.O.W. EL 675.5
EXCLUDER WALL
T.O.W. EL 666.4

SLAB EL 659.0

DIVIDER WALL
T.O.W. EL 674.0

UPSTREAM LIMIT OF EXISTING BARRIER

FISH SCREEN FACILITIES

16' RADIAL GATE

35' RADIAL GATE

TEMPORARY DIVERSION GATES

DIVERSION INTAKE CHANNEL

EXISTING DIVERSION GATES

FISH TRAP LADDER

PSE DIVERSION FLUME

HOLDING POOL

LOADING POOL

RIGHT BANK LEVEE, 60' WIDE EASEMENT

HATCHERY FISHWAY AWS

HATCHERY FISHTRAP

JIB CRANE

HATCHERY FISHWAY

FIXED CREST WEIR, TYP

RUBBER WEIRS

BARRIER APRON

DOWNSTREAM LIMITS OF EXISTING BARRIER

HATCHERY FISHWAY ENTRANCE

BYPASS RAMP GATE

FISH TRAP ENTRANCE

CONTROL BUILDING

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

OVERALL SITE PLAN

SCALE: 1"=50'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

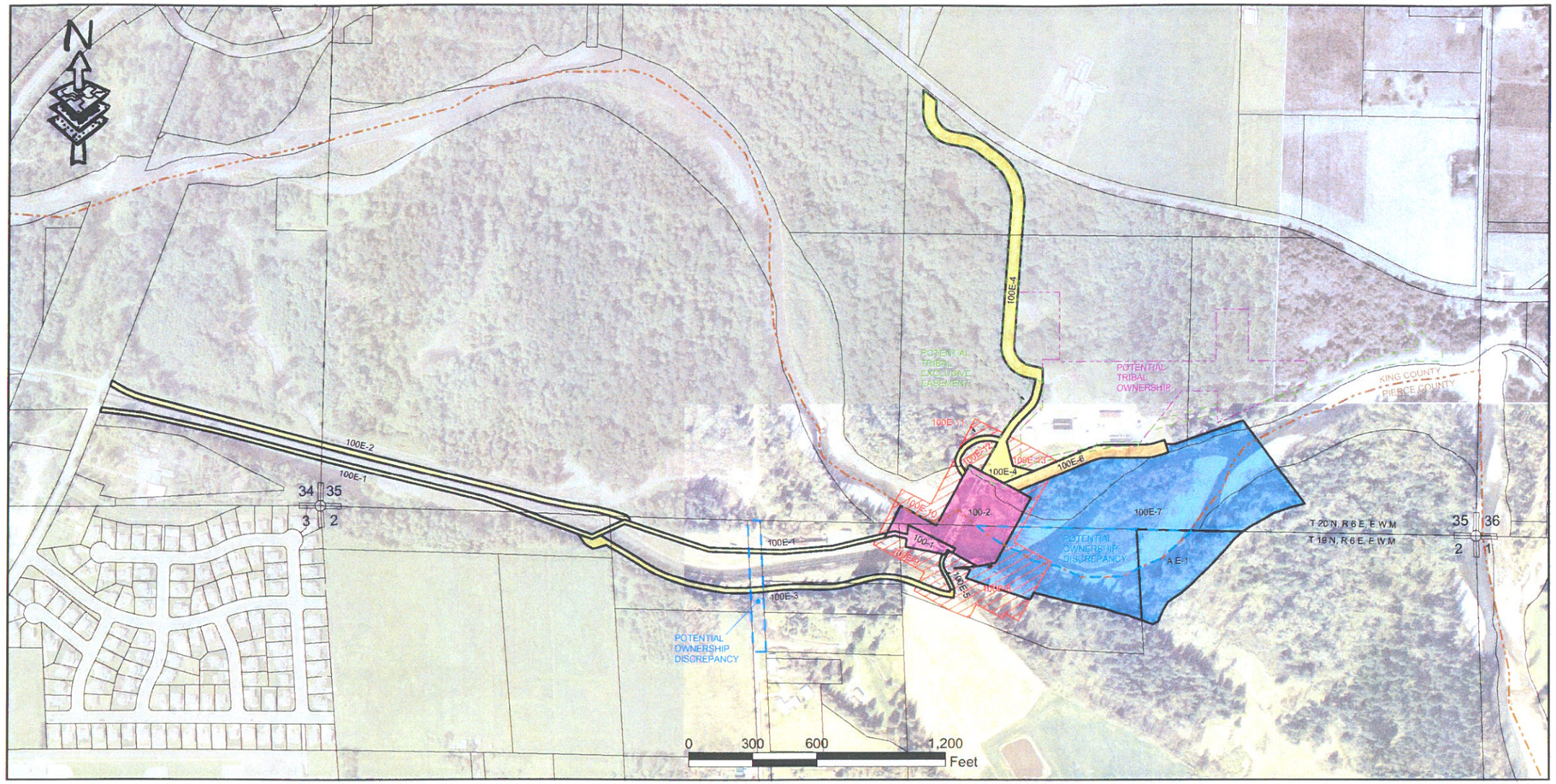
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
OVERALL SITE PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	——		2

DSGN: F.E.P. | CHK: D.E.D. | SHEET 2 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate02.dgn DATE AND TIME PLOTTED: 30-DEC-2004 12:03



LEGEND:

- COUNTY BOUNDARY
- POTENTIAL OWNERSHIP DISCREPANCY
- POTENTIAL TRIBAL OWNERSHIP
- POTENTIAL TRIBAL EXCL. ESMNT
- PARCELS
- TEMP. CONSTRUCTION EASEMENT
- FEE
- LEVEE EASEMENT
- FLOWAGE EASEMENT
- BRIDGE EASEMENT
- ROAD EASEMENT

SOURCE

1 BASED ON PROPERTY AND EASEMENT PLAN IN DESIGN PLATES OF FEDERAL PREFERRED ALTERNATIVE (FPA) ELECTRONIC DESIGN FILES FURNISHED BY MWH TO REAL ESTATE IN MARCH 2004 (PLATES 1-41) AND SEPTEMBER 2004 (PLATES 4-1 TO 4-4).

2 ALSO BASED ON MODIFICATIONS AND INPUT FROM PLANNING BRANCH, CIVIL PROJECT BRANCH, HYDRAULICS & HYDROLOGY SECTION, AND GEOLOGY & INSTRUMENTATION SECTION WITHIN THE SEATTLE DISTRICT OF USACE.

3. PARCEL OWNER INFORMATION BASED ON GIS DATA FROM KING AND PIERCE COUNTIES, METROSCAN, AND FIRST AMERICAN TITLE INSURANCE COMPANY

4. AERIAL ORTHOPHOTOS WAS AQCUIRED FROM TRIATHLON INC. AND ORIGINATE FROM 1998 (SOUTHEAST CORNER) AND 2002.

DISCLAIMER

THIS MAP IS BASED ON BEST AVAILABLE INFORMATION AT THE DATE INDICATED BELOW. OWNERSHIPS, PROPERTY BOUNDARIES, AND OTHER INPUT DATA ARE SUBJECT TO CONTINUING CHANGES. NO GUARANTEE OF ACCURACY IS GIVEN OR IMPLIED.

TABLE OF PROPOSED TRACTS

SYMBOL	TRACT ID	ESTATE	ACREAGE	OWNER	REMARKS
	100-1	FEE	0.40	PUGET SOUND ENERGY & ELECTR.	FEE SUBJECT TO EXISTING ACOE EASEMENT*
	100-2	FEE	3.23	PUGET SOUND ENERGY & ELECTR.	FEE WITH IMPROVEMENTS
	100E-2	EASEMENT	1.44	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-3	EASEMENT	1.09	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-4	EASEMENT	3.17	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-5	EASEMENT	0.08	PUGET SOUND ENERGY & ELECTR.	BRIDGE EASEMENT
	100E-6	EASEMENT	1.05	PUGET SOUND ENERGY & ELECTR.	LEVEE EASEMENT
	100E-7	EASEMENT	15.34	PUGET SOUND ENERGY & ELECTR.	PERMANENT FLOWAGE EASEMENT
	A E-1	EASEMENT	2.75	WASH. STATE DEPT. SOCIAL SVCS	PERMANENT FLOWAGE EASEMENT
	100E-8	EASEMENT	3.03	PUGET SOUND ENERGY & ELECTR.	TEMP. CONSTR. EASEMENT, 1.60 ACS INCLUDED IN 100E-7
	100E-9	EASEMENT	0.78	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-10	EASEMENT	0.81	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-11	EASEMENT	0.21	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-12	EASEMENT	0.34	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-13	EASEMENT	0.44	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
		GROSS TOTAL	**34.16**	(NET TOTAL **32.56** ACS AFTER DEDUCTING OVERLAPPING AREA WITHIN TRACT 100E-8)	

SUMMARY TABLE OF PROPOSED ACQUISITION

SYMBOL	OWNER	ESTATE	REMARKS	ACREAGE
	PUGET SOUND ENERGY & ELECTR.	FEE	FEE SUBJECT TO EXISTING ACOE EASEMENT*	0.40
	PUGET SOUND ENERGY & ELECTR.	FEE	FEE WITH IMPROVEMENTS	3.23
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	ROAD EASEMENTS	5.70
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	LEVEE EASEMENTS	1.05
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	BRIDGE EASEMENTS	0.08
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	PERMANENT FLOWAGE EASEMENTS	15.34
	WASH. STATE DEPT. SOCIAL SVCS	EASEMENT	PERMANENT FLOWAGE EASEMENTS	2.75
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	TEMPORARY CONSTRUCTION EASEMENTS	5.61
			TOTAL	**34.16**

TABLE OF EXISTING TRACTS

SYMBOL	Tract ID	Estate	Acreage	Owner	Remarks
	100E-1	EASEMENT	1.74	PUGET SOUND ENERGY & ELECTR.	EXISTING EASEMENT*

* CURRENT TRACT B100E FOR ROAD R/W AND FISH FACILITIES (DEED 22 MAY 1950)

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE PROPERTY AND EASEMENT PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B			3

DSGN: F.E.P. | CHK: D.E.D. | SHEET 3 OF 41

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DATE AND TIME PLOTTED: $$$$date$$$$

RIGHT BANK LEVEE,
60' WIDE EASEMENT

PARKING AREA

DIVERSION DAM

WHITE RIVER

CONTROL BUILDING

PROJECT PROPERTY
LIMITS

FISH TRAP
FACILITIES

TEMPORARY
CONSTRUCTION
EASEMENT

DIVERSION DAM AND TRAP FACILITIES ENLARGEMENT PLAN

SCALE: 1" = 100'

MWH

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

VEGETATION PLAN LEGEND:

A: RE-PLANT DISTURBED ROAD EASEMENT
VINE MAPLE (ACER CIRCINATUM)
SALMONBERRY (RUBUS SPECTABILIS)
THIMBLEBERRY (RUBUS PARVIFLORUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)

B: DE-COMMISSION ACCESS ROAD/RE-PLANT
DOUGLAS-FIR (PSEUDOTSUGA MENZIESII)
WESTERN HEMLOCK (TSUGA HETEROPHYLLA)
BIG-LEAF MAPLE (ACER MACROPHYLLUM)
BLACK COTTONWOOD (POPULUS BALSAMIFERA)
VINE MAPLE (ACER CIRCINATUM)
SNOWBERRY (SYMPHORICARPOS ALBUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SWORD FERN (POLYSTICHUM MUNITUM)

C: PLANT LEVEE SLOPES/RIPARIAN-WILLOW
THIMBLEBERRY (RUBUS PARVIFLORUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SNOWBERRY (SYMPHORICARPOS ALBUS)
OCEANSPRAY (HOLODISCUS DISCOLOR)

D: INCIDENTAL DISTURBANCE/UPLAND PLANTING
DOUGLAS-FIR (PSEUDOTSUGA MENZIESII)
BIG-LEAF MAPLE (ACER MACROPHYLLUM)
VINE MAPLE (ACER CIRCINATUM)
SNOWBERRY (SYMPHORICARPOS ALBUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SERVICEBERRY (AMELANCHIER ALNIFOLIA)
SWORD FERN (POLYSTICHUM MUNITUM)

CONTINUE

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
PROJECT FOOTPRINT AND
PLANTING PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		4

DSGN: F.E.P.	CHK: D.E.D.	SHEET 4 OF 41

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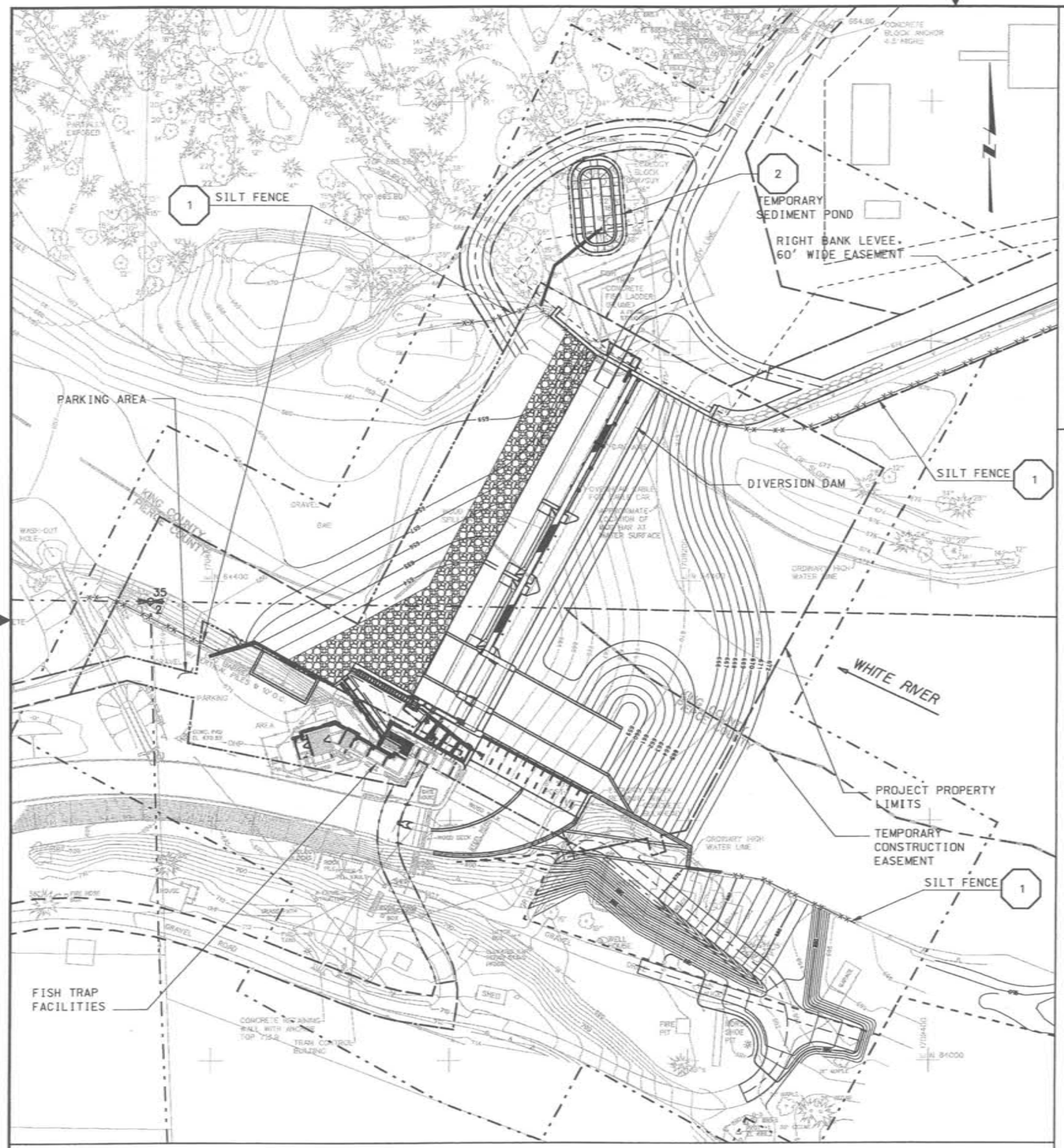
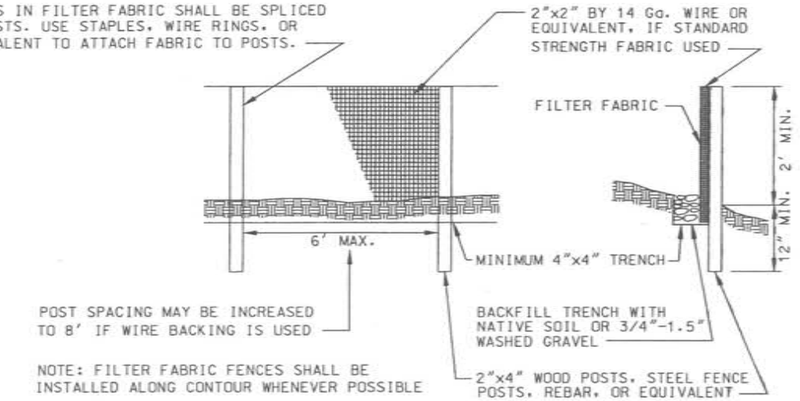


EROSION - SEDIMENT AND WATER CONTROL PLAN

SCALE: 1" = 100'

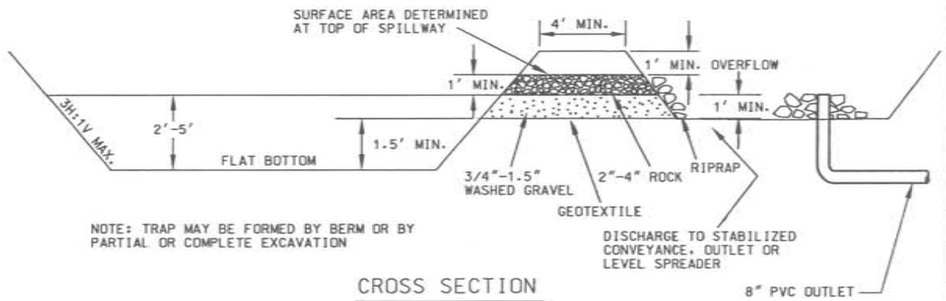
JOINTS IN FILTER FABRIC SHALL BE SPLICED AT POSTS. USE STAPLES, WIRE RINGS, OR EQUIVALENT TO ATTACH FABRIC TO POSTS.



NOTE: FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE

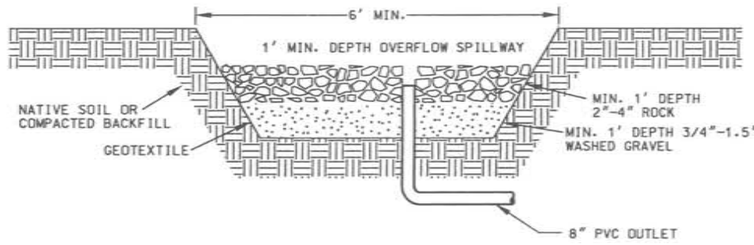
SILT FENCE 1

NOT TO SCALE



NOTE: TRAP MAY BE FORMED BY BERM OR BY PARTIAL OR COMPLETE EXCAVATION

CROSS SECTION



TEMPORARY SEDIMENT POND 2

NOT TO SCALE

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
EROSION – SEDIMENT AND WATER CONTROL PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	—		5
DSGN: F.E.P.	CHK: D.E.D.	SHEET 5 OF 41	

MWH

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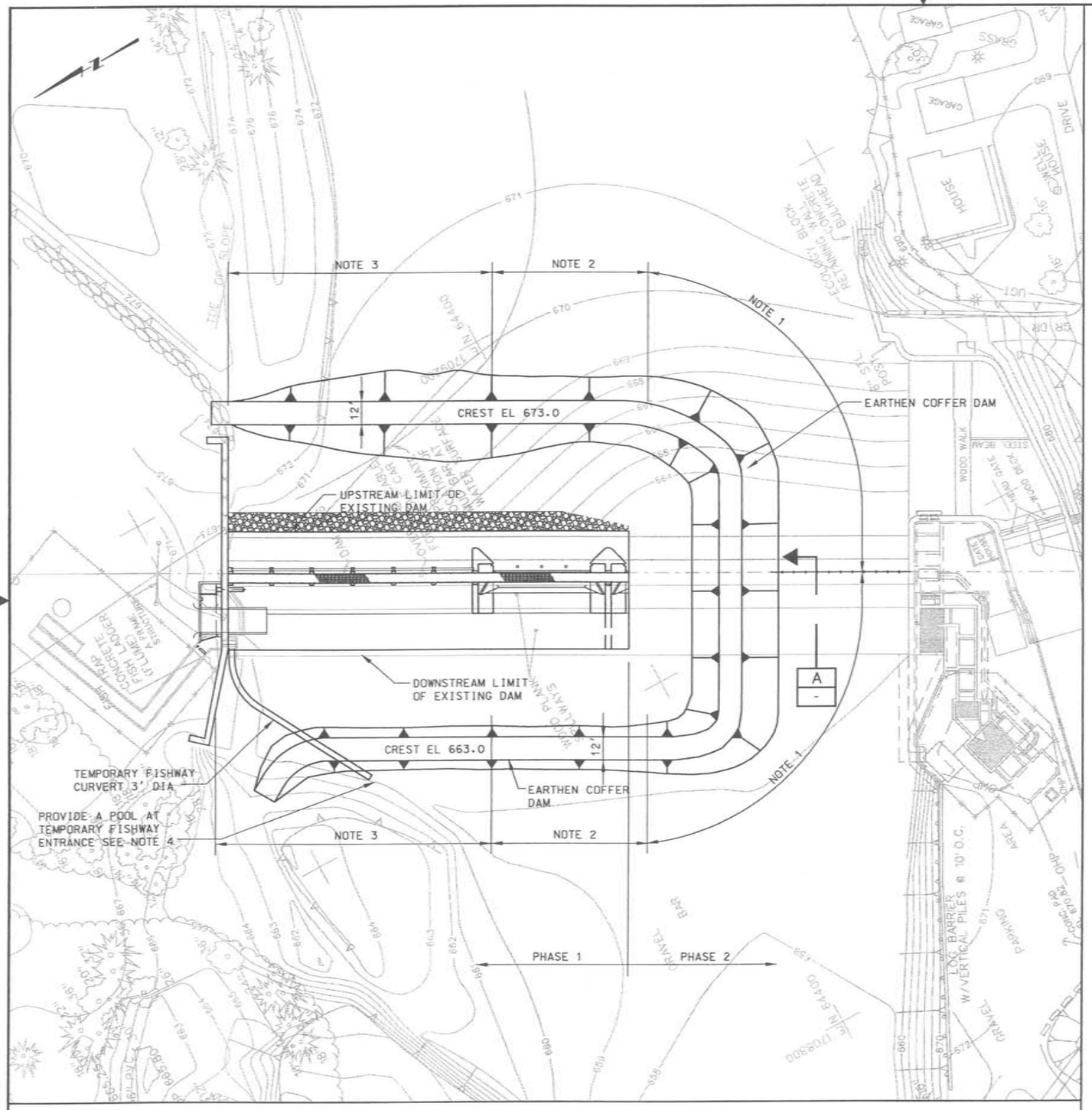

PHASE 1 COFFERDAM PLAN

SCALE: 1" = 60'

NOTES:

1 TYPE I COFFERDAM. SEE PLATE 7.

2 TYPE II COFFERDAM. SEE PLATE 7.

3 TYPE III COFFERDAM. SEE PLATE 7.

4 TEMPORARY FISHWAY CULVERT ENTRANCE TO BE SMOOTH, WITH A HEADWALL, AND NON-ERODABLE FOUNDATION.

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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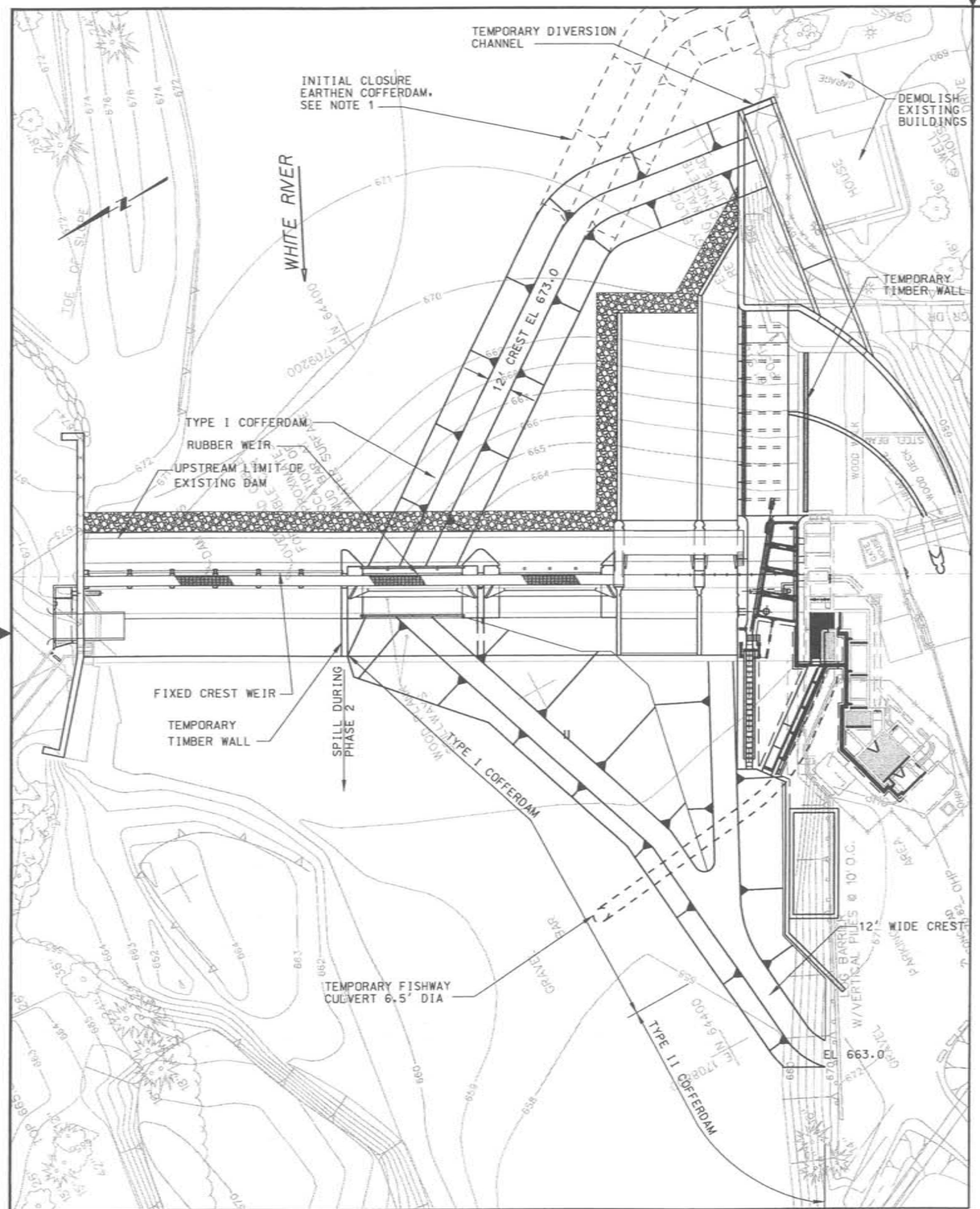
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
PHASE 1 COFFERDAM
PLAN AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		6

DSGN: F.E.P. | CHK: D.E.D. | SHEET 6 OF 41

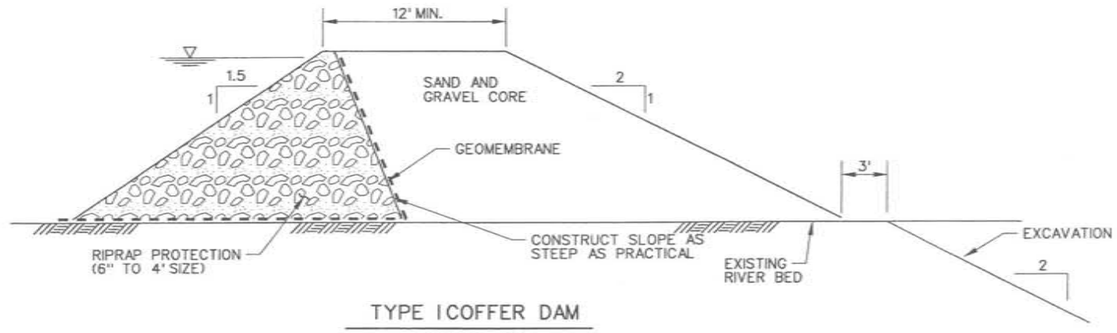
MWH

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate06.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:19



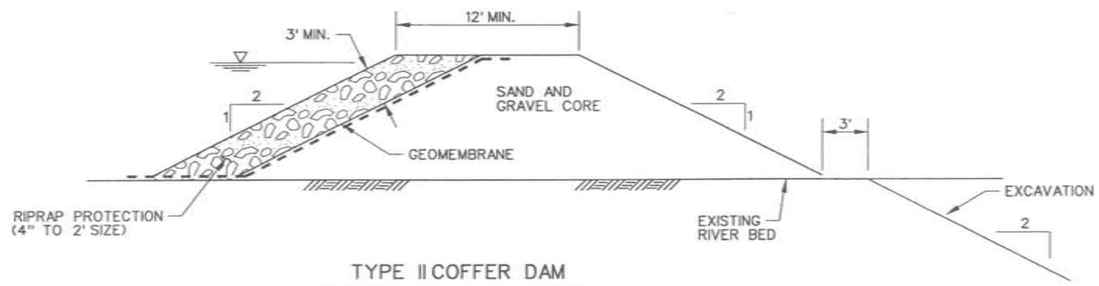
PHASE 2 COFFERDAM PLAN

SCALE: 1" = 60'



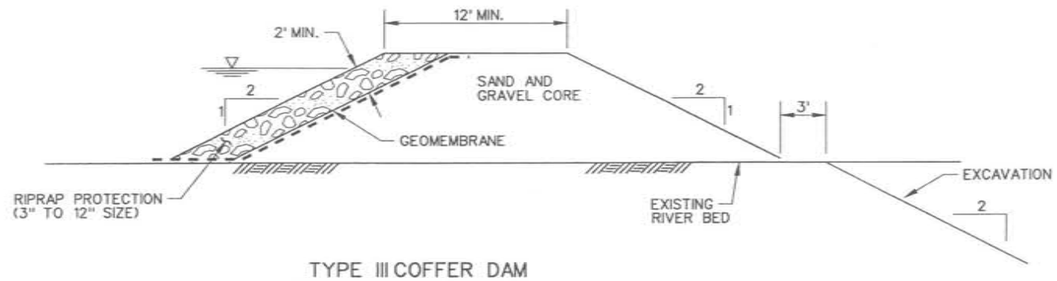
TYPE I COFFER DAM

SCALE: 1" = 10'



TYPE II COFFER DAM

SCALE: 1" = 10'



TYPE III COFFER DAM

SCALE: 1" = 10'

NOTES:

1 INITIALLY THE COFFERDAM WILL BE EXTENDED TO CONSTRUCT THE TEMPORARY DIVERSION CHANNEL, INTAKE SLAB, OUTER INTAKE WALLS AND TEMPORARY TIMBER WALL. THE THE DIVERSION WILL BE RE-ESTABLISHED AND THE COFFEDAM SHORTENED.

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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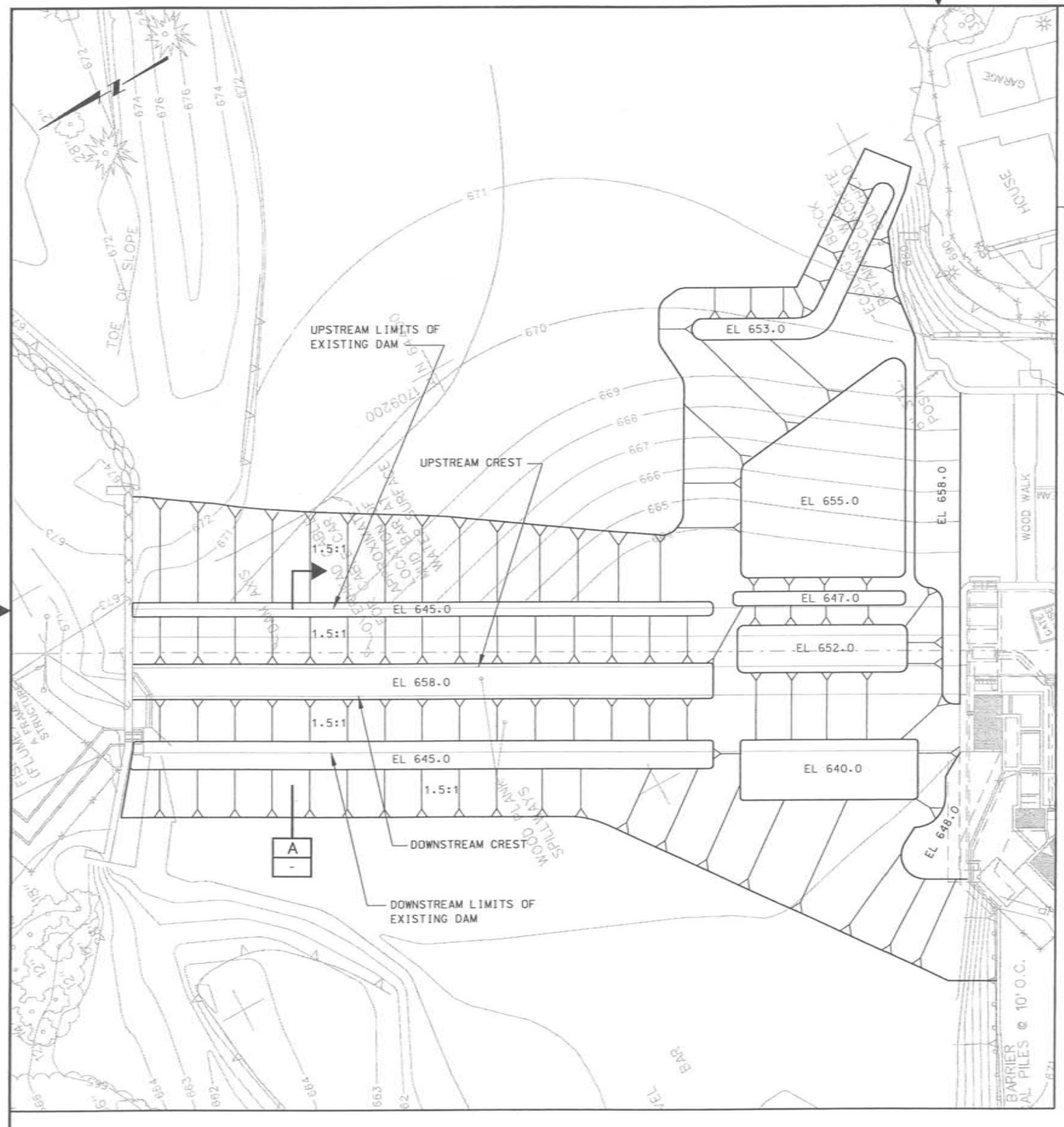
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
PHASE 2 COFFERDAM
PLAN AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		7

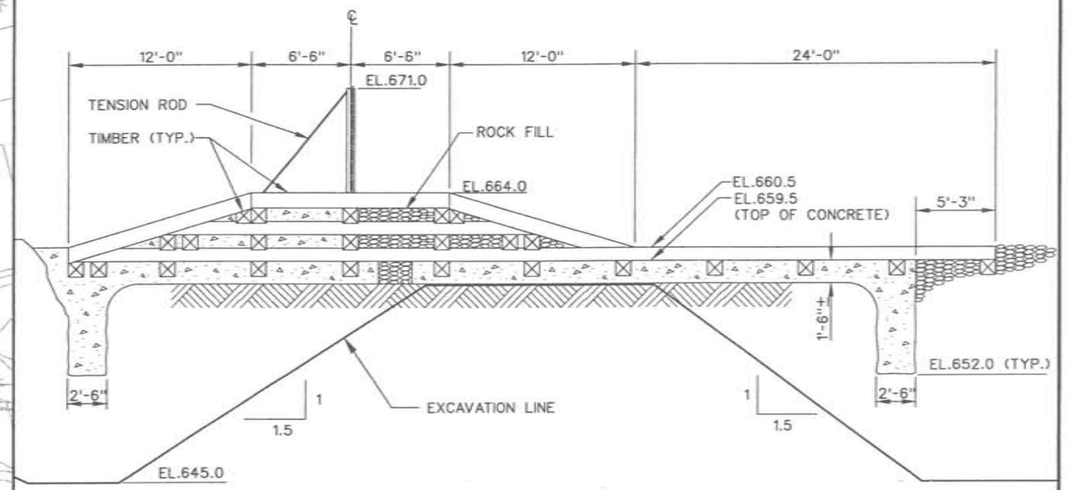
DSGN: F.E.P. | CHK: D.E.D. | SHEET 7 OF 41

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate07.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:19



DAM FOUNDATION EXCAVATION PLAN

SCALE: 1" = 50'



EXISTING DAM SECTION — A / -

SCALE: 1" = 10'

NOTES:

1 EXISTING DAM DIMENSIONS ARE BASED ON THE ORIGINAL DAM DRAWINGS, DATED SEPT 29, 1910. CONTRACTOR SHALL VERIFY ALL DIMENSIONS.

2 EXCAVATION FOR DEWATERING SHALL BE DESIGNED BY CONTRACTOR. LIMIT SHOWN DEPICT STRUCTURE SUBGRADE.

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

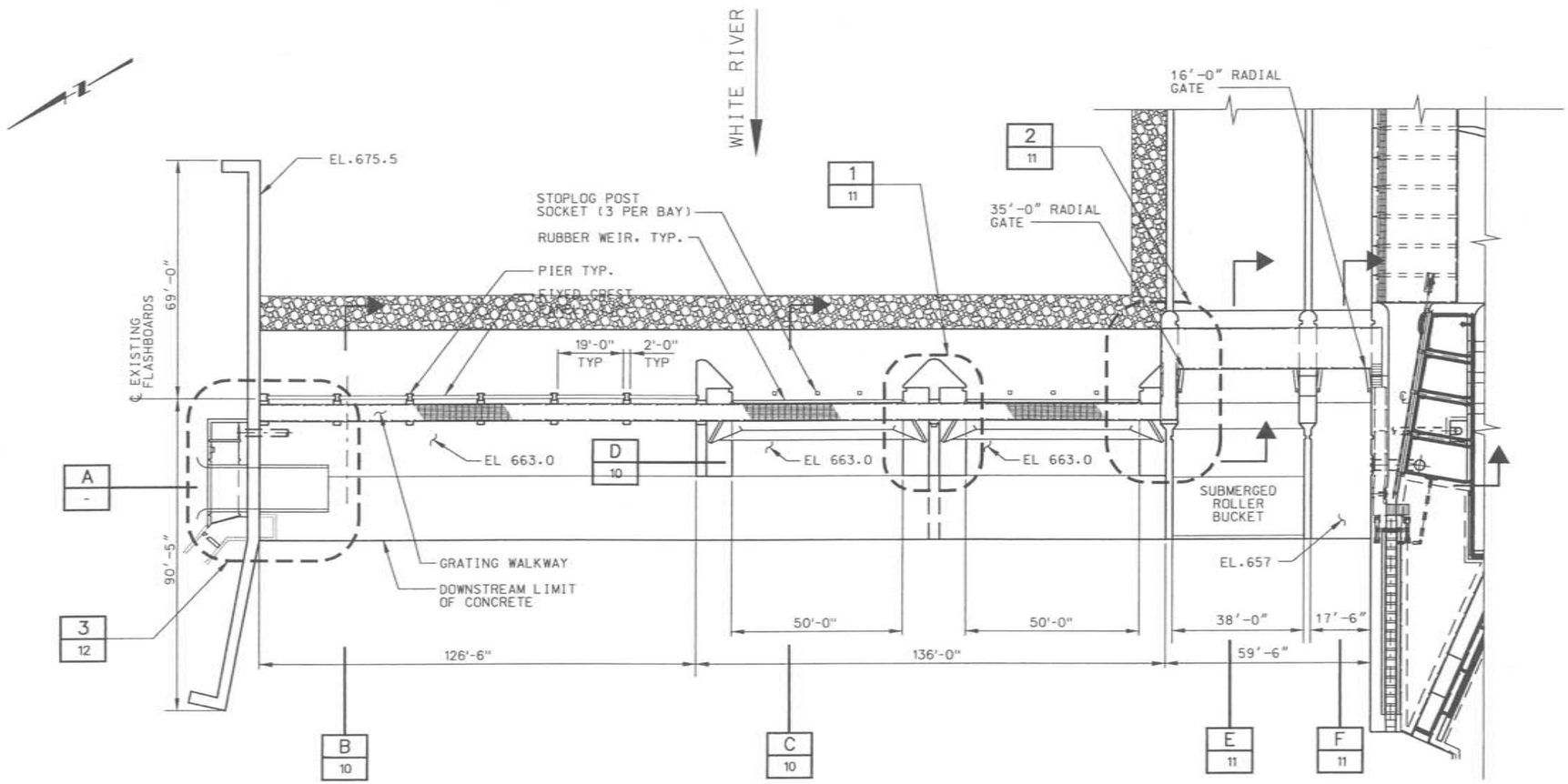
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
BARRIER DAM FOUNDATION EXCAVATION PLAN AND SECTION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		8

DSGN: F.E.P. | CHK: D.E.D. | SHEET 8 OF 41

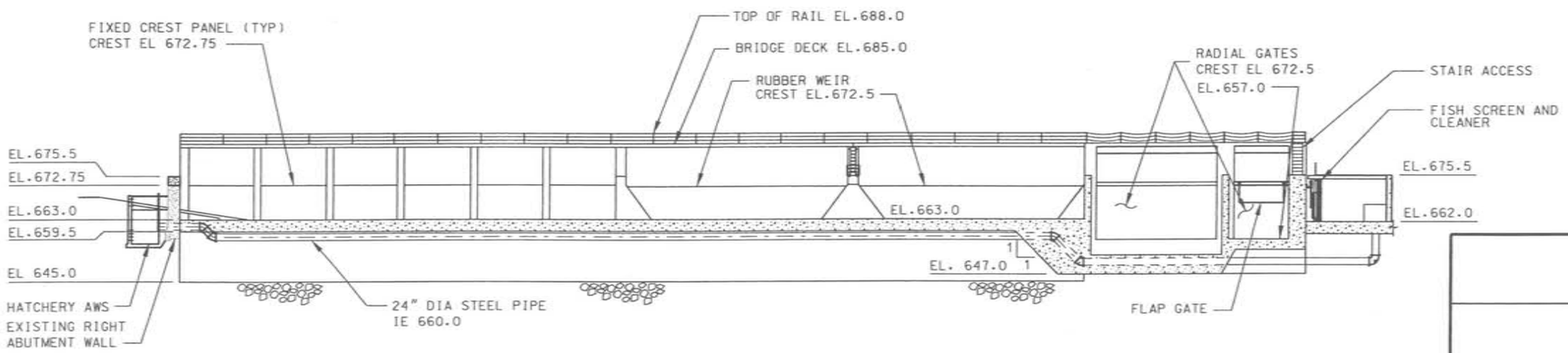
MWH

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate08.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:19



DAM PLAN

SCALE: 1" = 40'



DAM ELEVATION A -

SCALE: 1" = 40'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

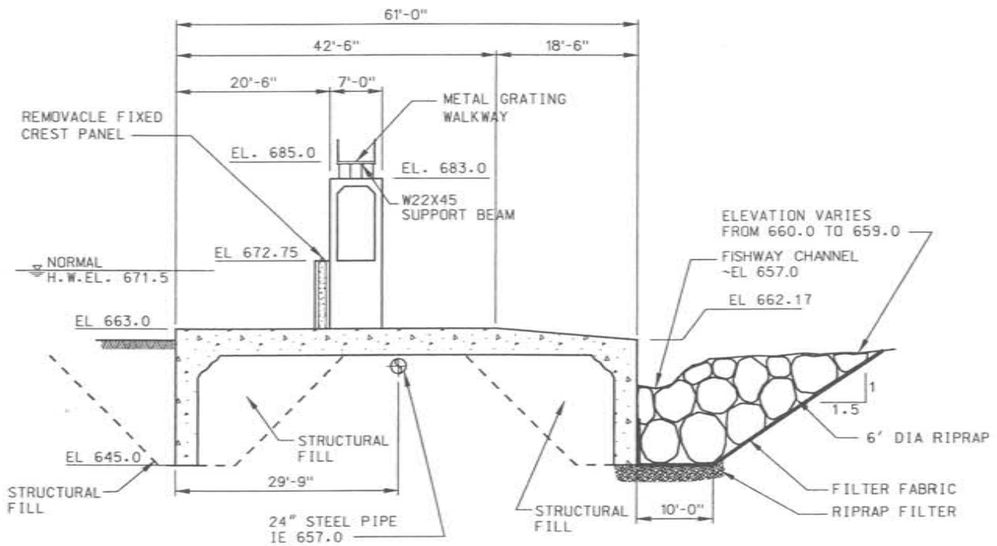
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
BARRIER DAM PLAN AND ELEVATION

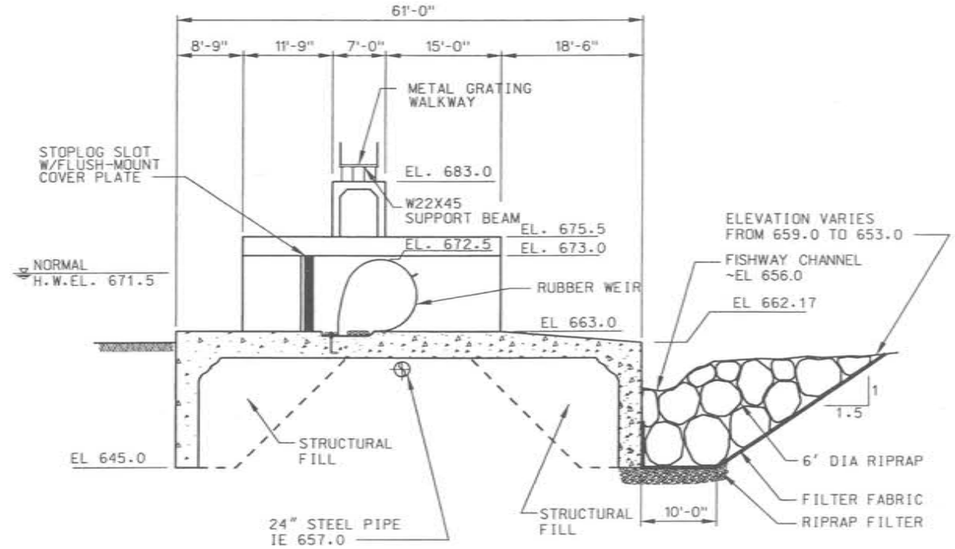
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		9

DSGN: F.E.P. | CHK: D.E.D. | SHEET 9 OF 41

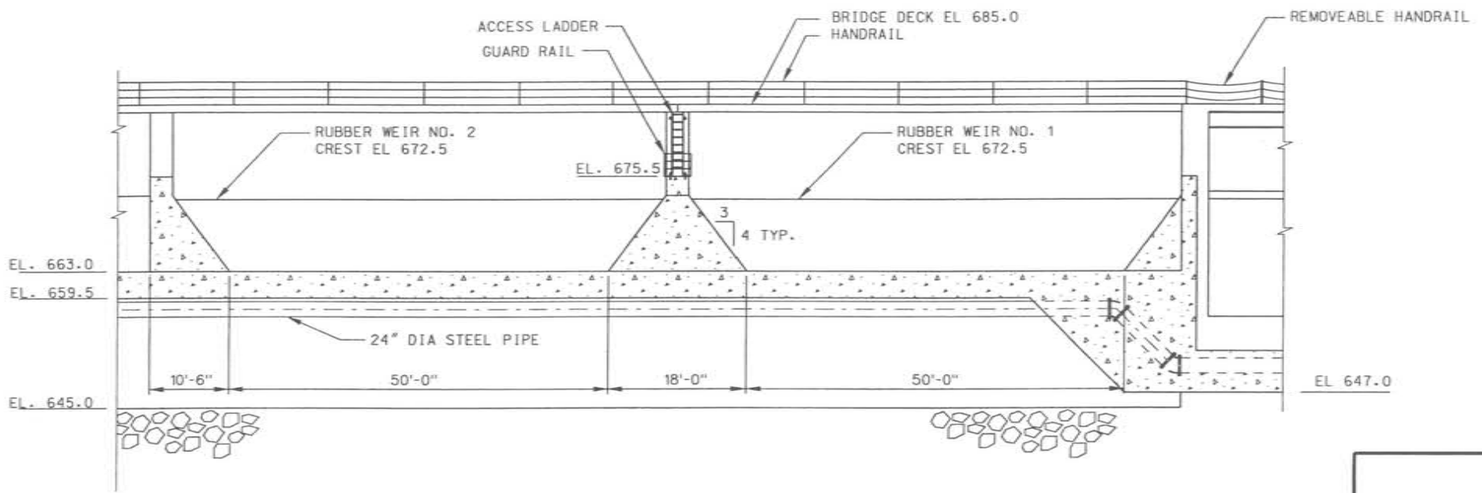
DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate09.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:19



SECTION B
SCALE: 1" = 20'



SECTION C
SCALE: 1" = 20'



SECTION D
SCALE: 1" = 20'

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

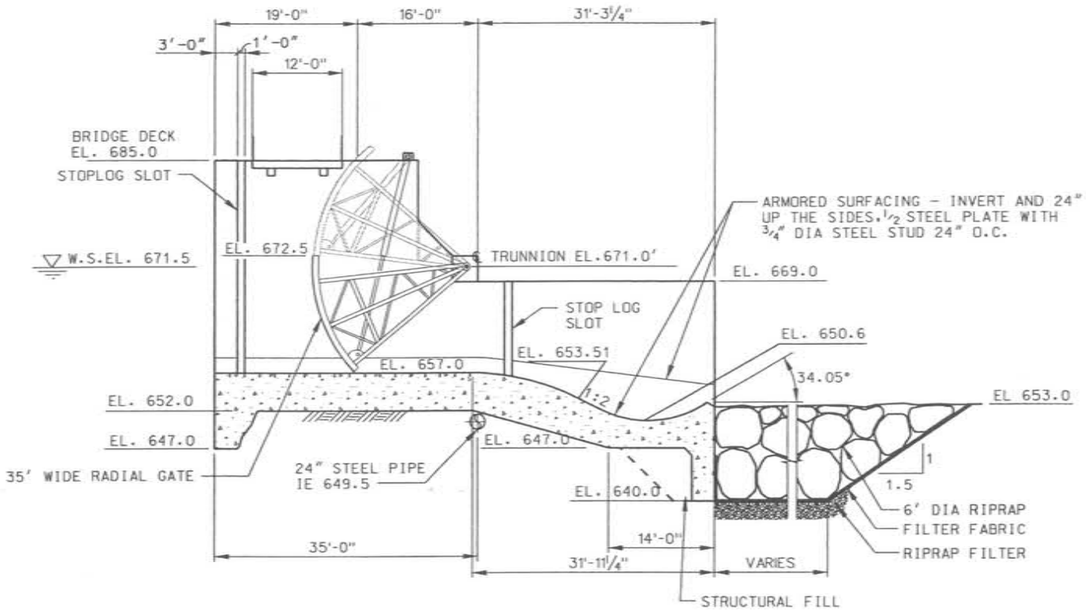
LOCALLY PREFERRED ALTERNATIVE
BARRIER DAM SECTIONS 1

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		10

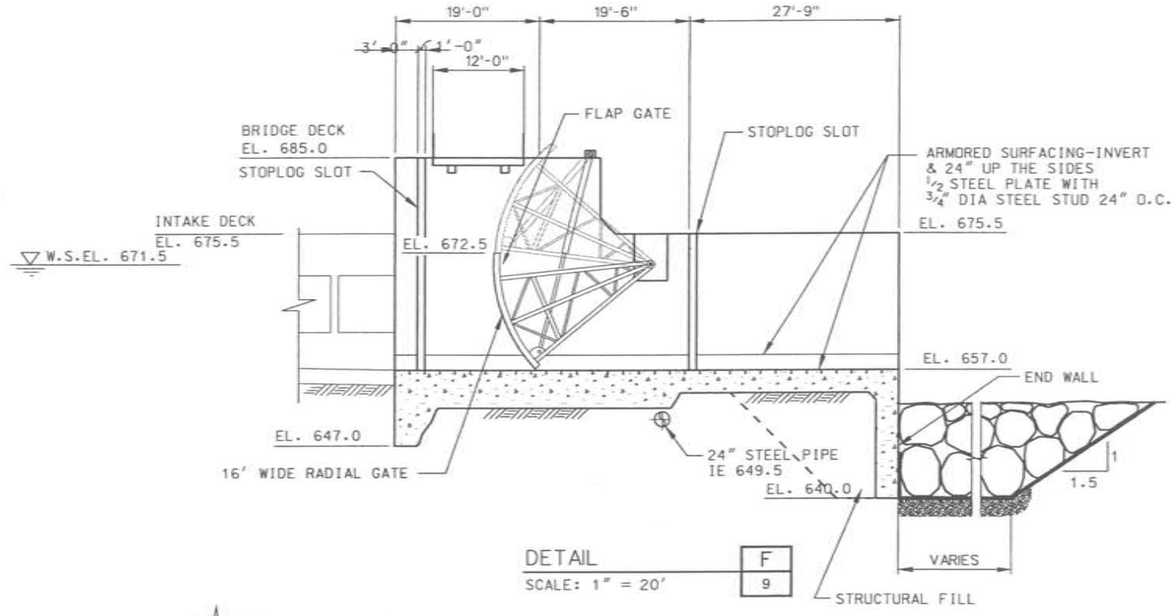
DSGN: F.E.P. | CHK: D.E.D. | SHEET 10 OF 41

MWH

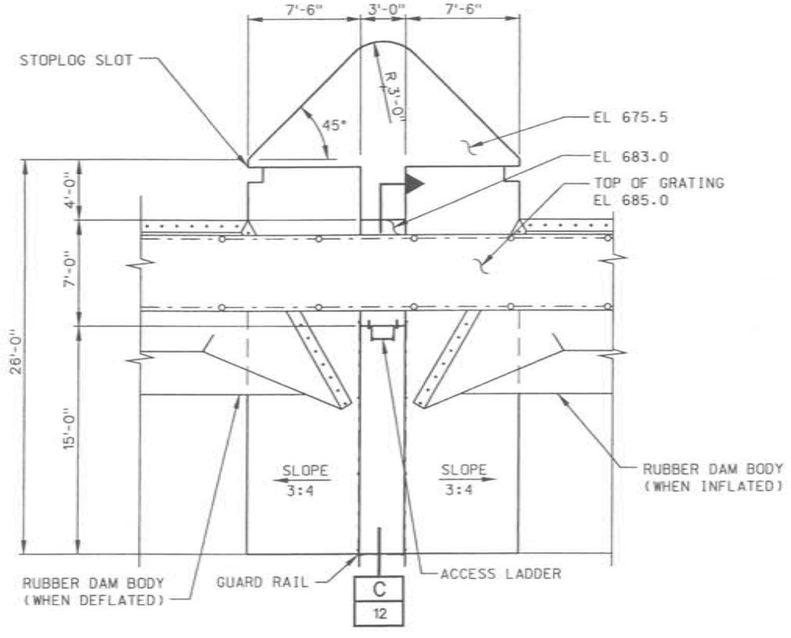
DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate10.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:19



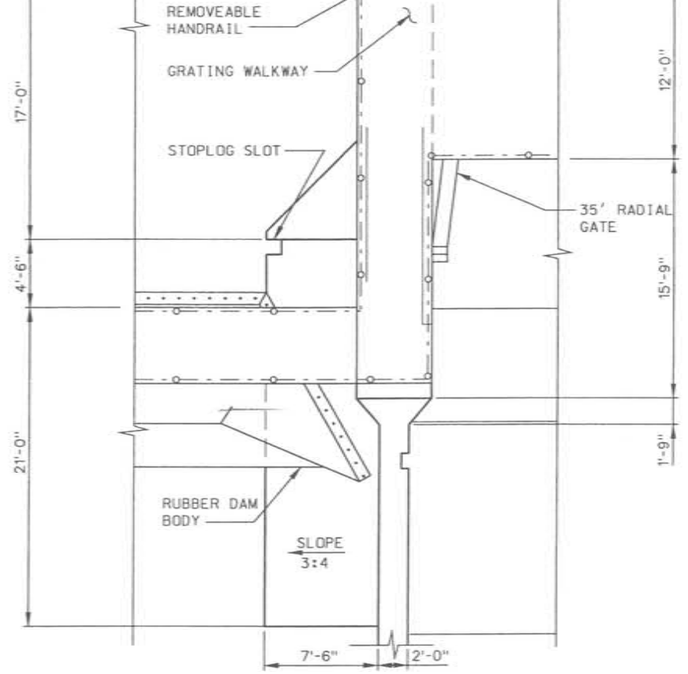
DETAIL E
SCALE: 1" = 20' 9



DETAIL F
SCALE: 1" = 20' 9



DETAIL 1
SCALE: 1" = 10' 9



DETAIL 2
SCALE: 1" = 10' 9

MWH

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CORPS OF ENGINEERS
SEATTLE, WASHINGTON

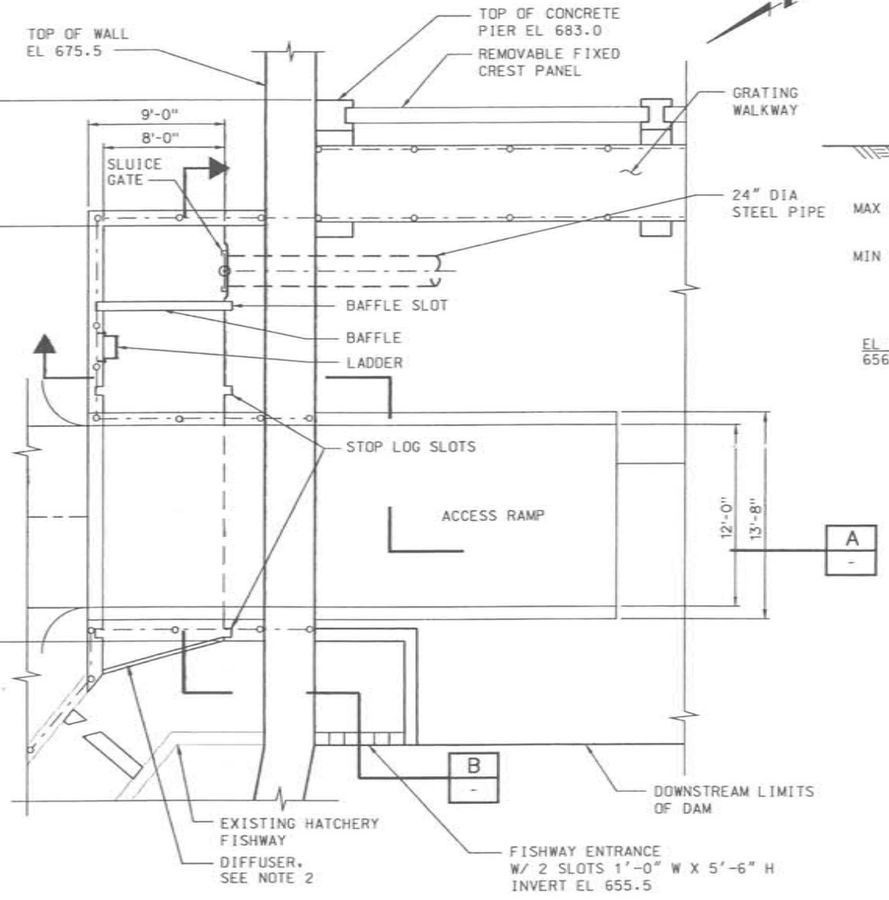
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
BARRIER DAM SECTION 2

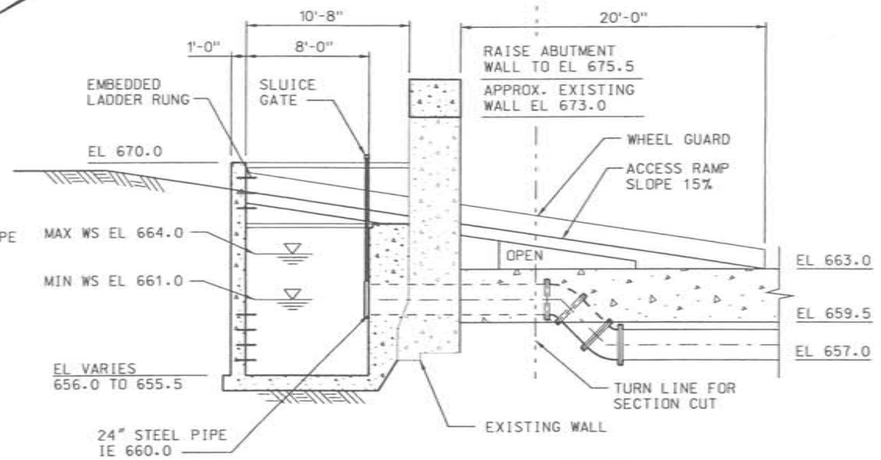
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		11

DSGN: F.E.P. | CHK: D.E.D. | SHEET 11 OF 41

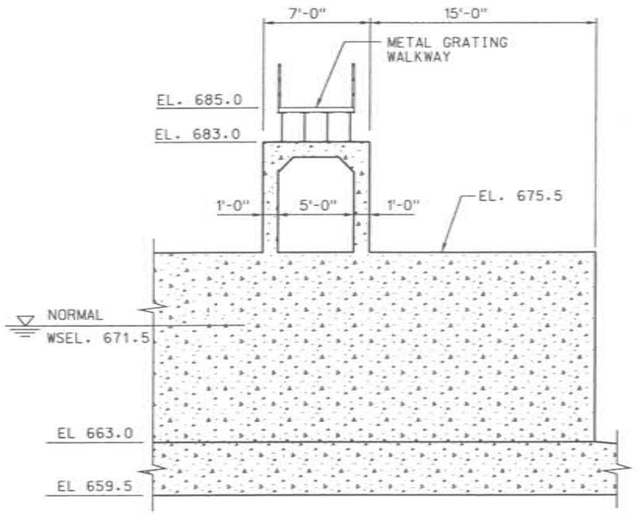
DESIGN FILE: \\Ussea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate11.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:19



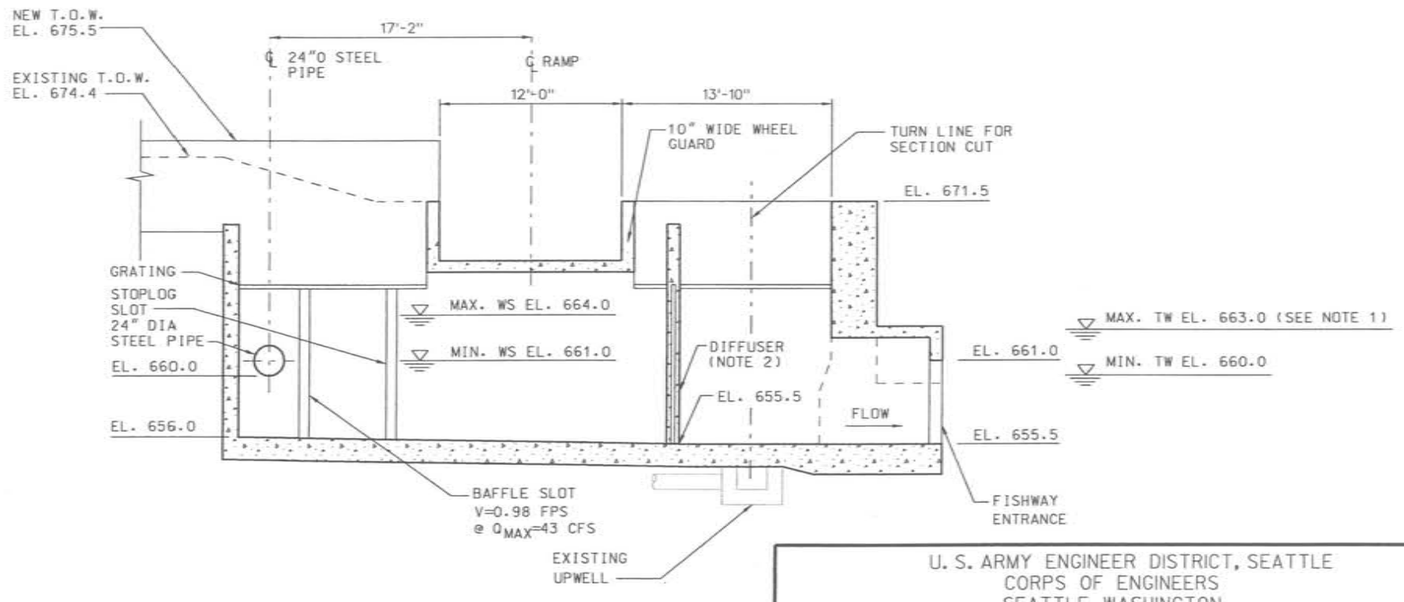
DETAIL 3 / SCALE: 1" = 10' 9



SECTION A / SCALE: 1" = 10'



SECTION C / SCALE: 1" = 10' 11



SECTION B / SCALE: 1" = 10' -

NOTES:

1 MAXIMUM AND MINIMUM WATER SURFACE ELEVATIONS REFER TO THE RANGE OF ELEVATIONS FOR FISHERY CONCERNS, AND ARE NOT INTENDED TO REPRESENT HYDROLOGIC MAXIMUM AND MINIMUMS.

2 DIFFUSER WITH 1-INCH BAR SPACING AND AN APPROACH VELOCITY OF 1 FPS.

MWH

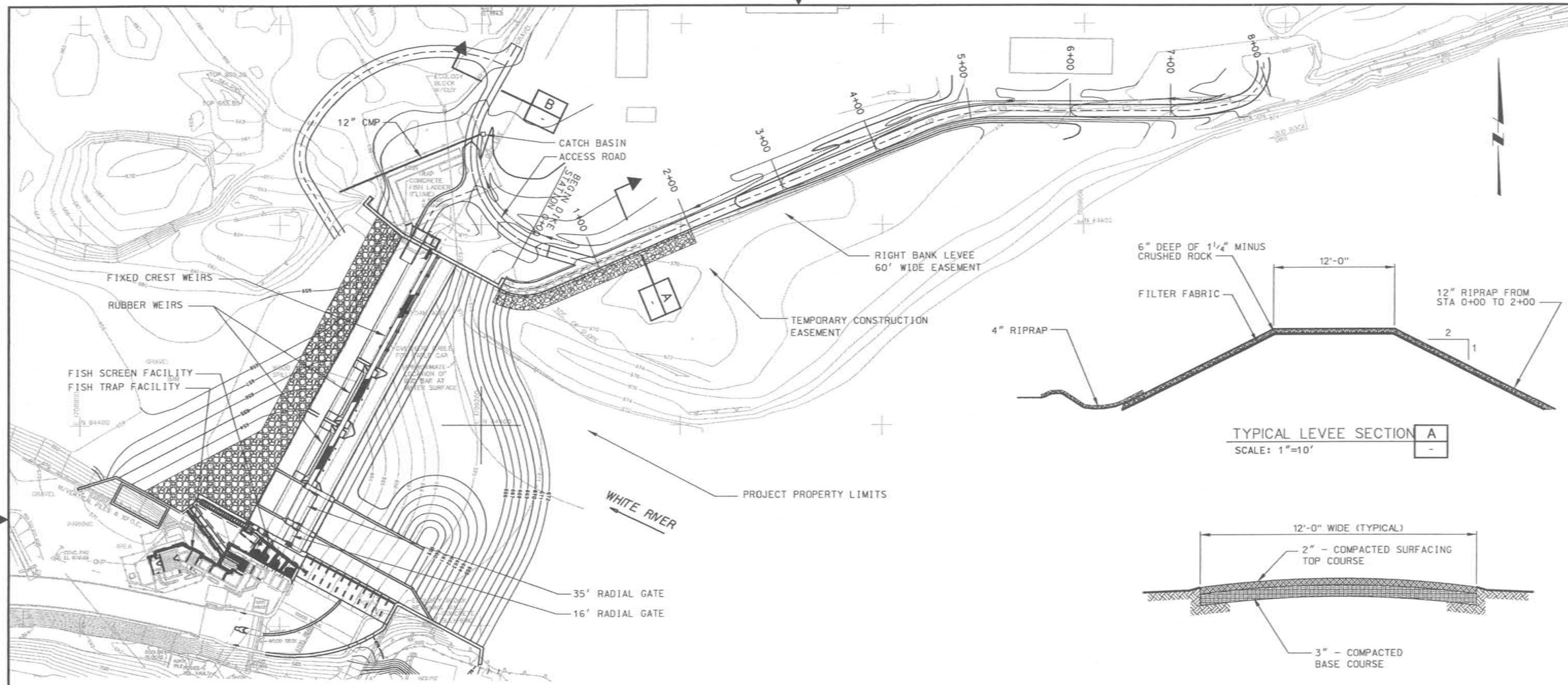
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
BARRIER DAM SECTIONS 3

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		12

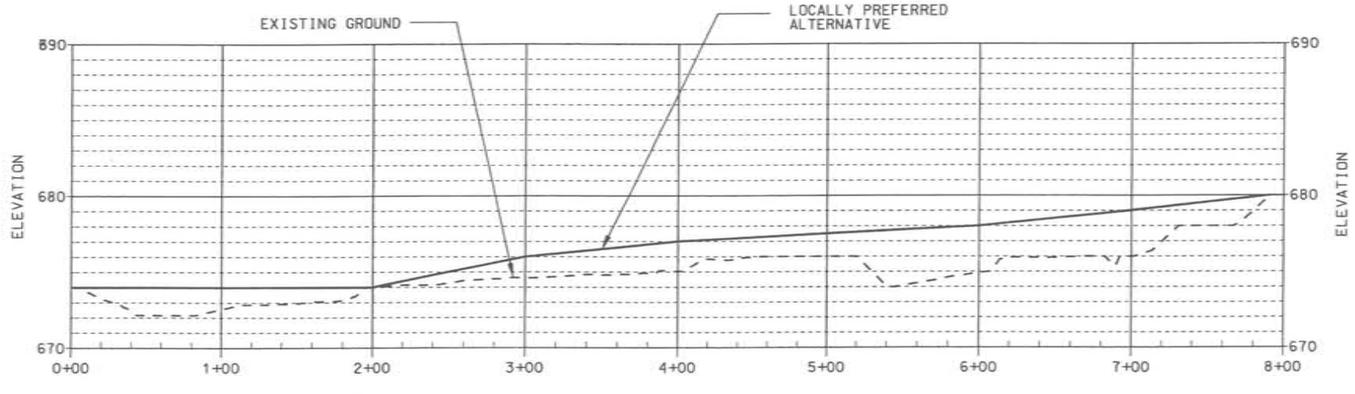
DSGN: F.E.P. | CHK: D.E.D. | SHEET 12 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate12.dgnDATE AND TIME PLOTTED: 30-DEC-2004 13:19



TYPICAL LEVEE SECTION A
SCALE: 1"=10'

TYPICAL ROAD SECTION B
NOT TO SCALE



LEVEE PROFILE
HORIZ SCALE: 1"=100' VERT SCALE: 1"=10'

MWH

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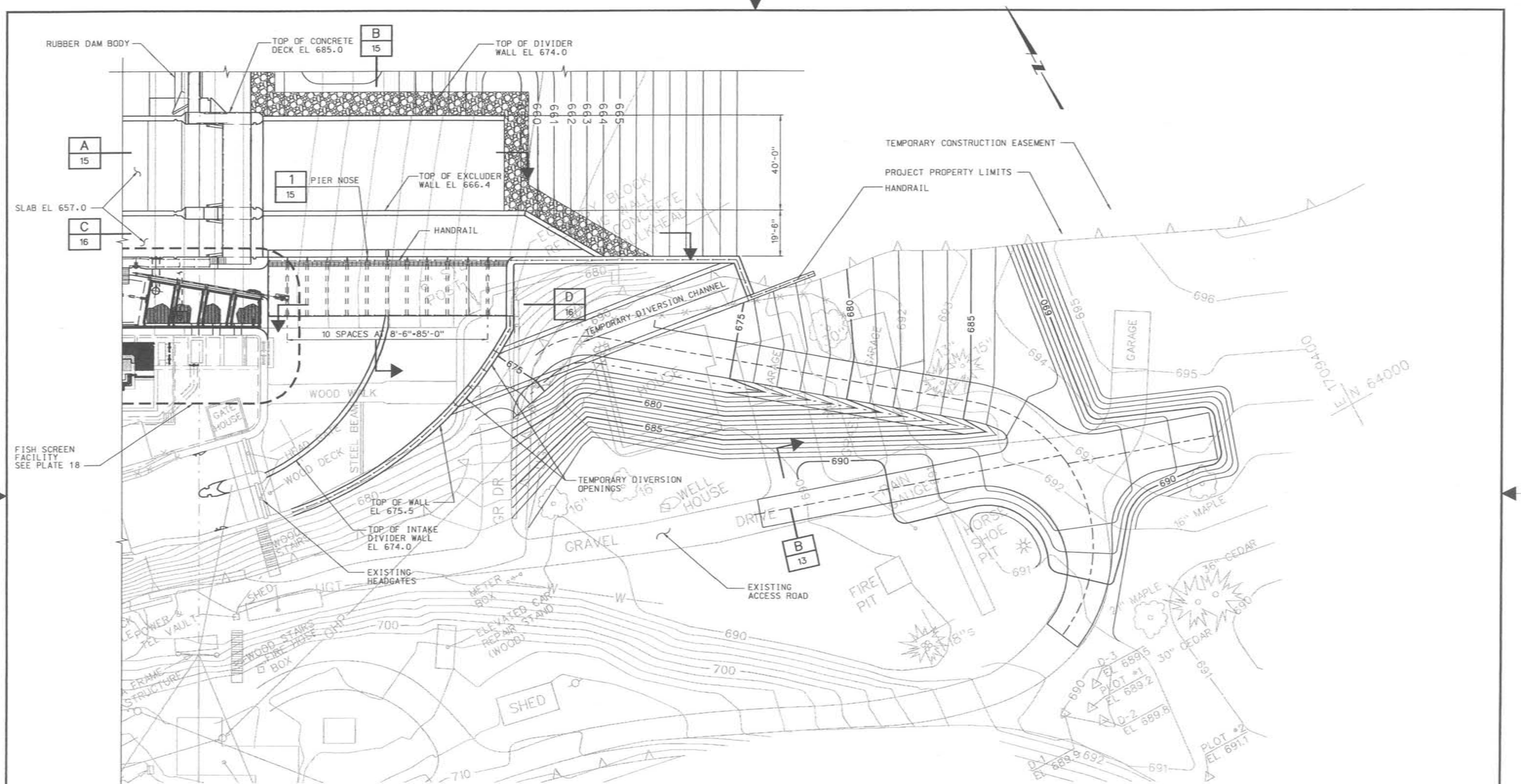
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
LEVEE AND RIVER BANK PLAN
PROFILE AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		13

DSGN: F.E.P. | CHK: D.E.D. | SHEET 13 OF 41

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate13.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:20



INTAKE PLAN

SCALE: 1" = 40'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

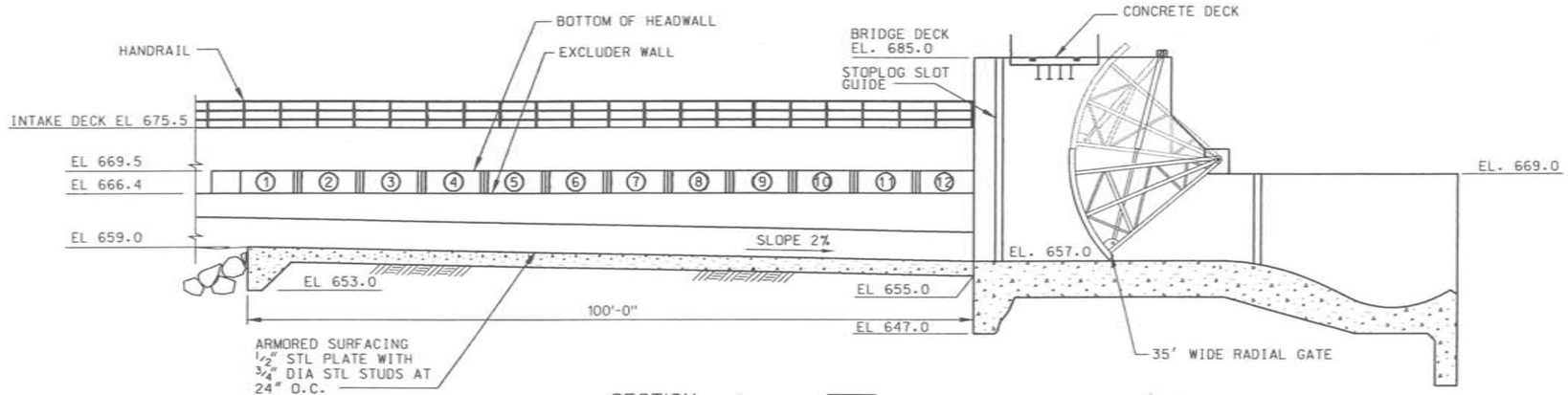
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
INTAKE PLAN

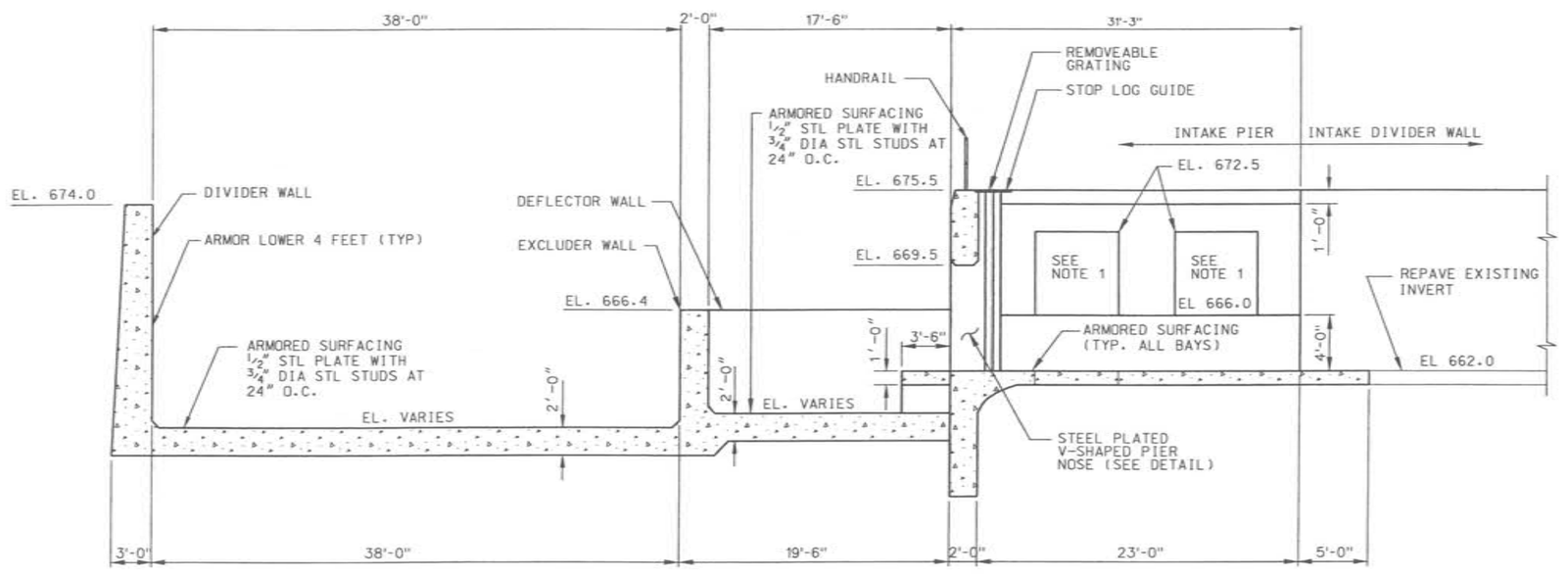
SIZE	INVITATION NO.	FILE NO.	PLATE
B			14

DSGN: F.E.P.	CHK: D.E.D.	SHEET 14 OF 41

DESIGN FILE: \\Usseatsd1\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate14.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:20



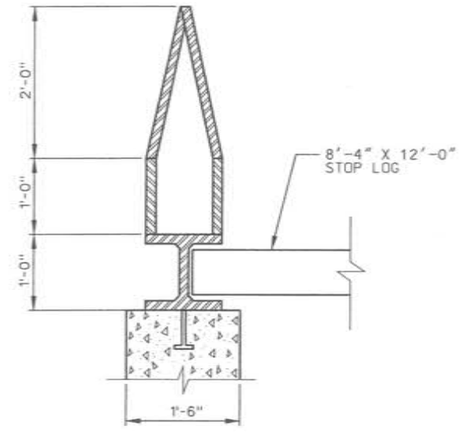
SECTION A
SCALE: 1" = 20'
14



NOTES:

1. TWO 6'-0" X 6'-6" OPENINGS IN PIERS AS SHOWN BETWEEN BAYS 10/11 AND 11/12.

SECTION B
SCALE: 3/32" = 1'-0"
14



PIER NOSE AND STOP LOG DETAIL 1
SCALE: 1/2" = 1'-0"
14

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

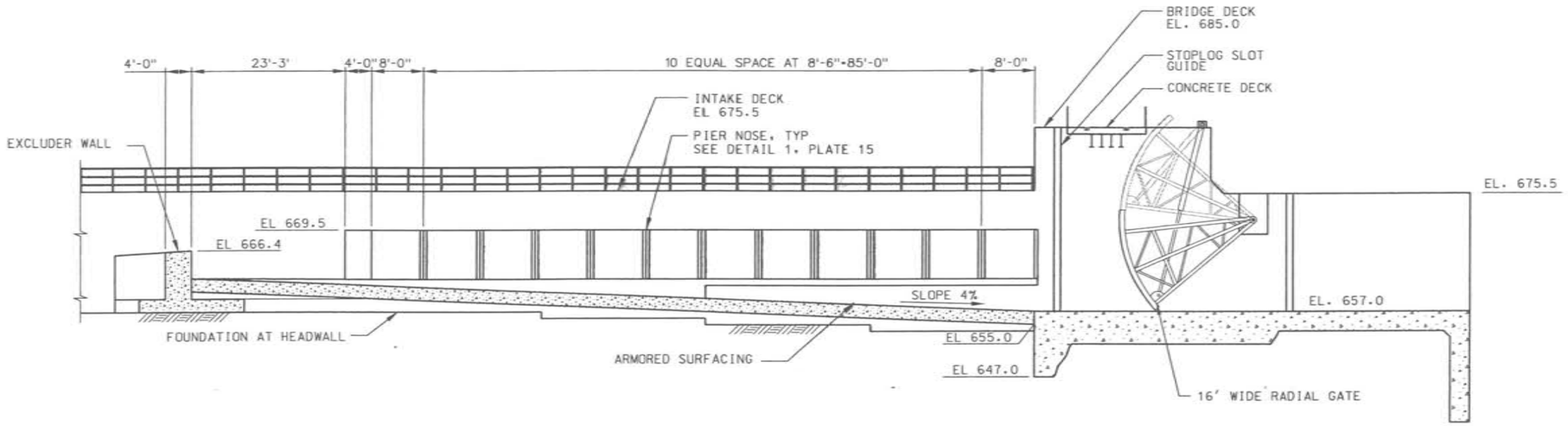
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE
INTAKE SECTIONS AND DETAILS 1

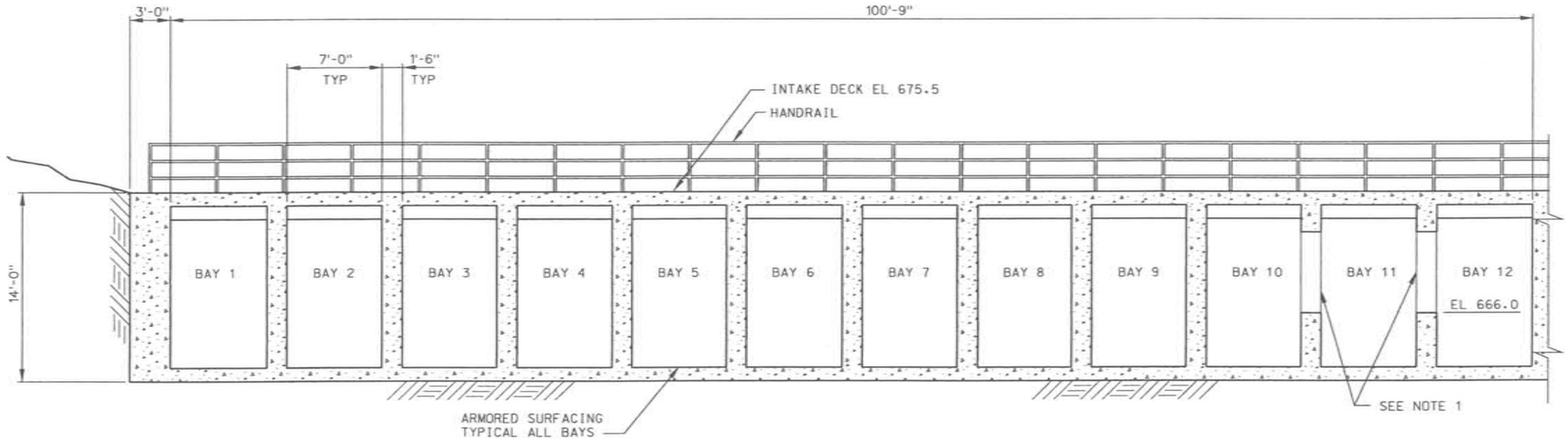
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		15

DSGN: F.E.P. | CHK: D.E.D. | SHEET 15 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate15.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:20



SECTION C
SCALE: 1" = 20' 14



SECTION D
SCALE: 1" = 10' 14

NOTES:

1. TWO 6' X 6.5' OPENINGS IN PIERS AS SHOWN BETWEEN BAYS 10/11 AND 11/12.

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

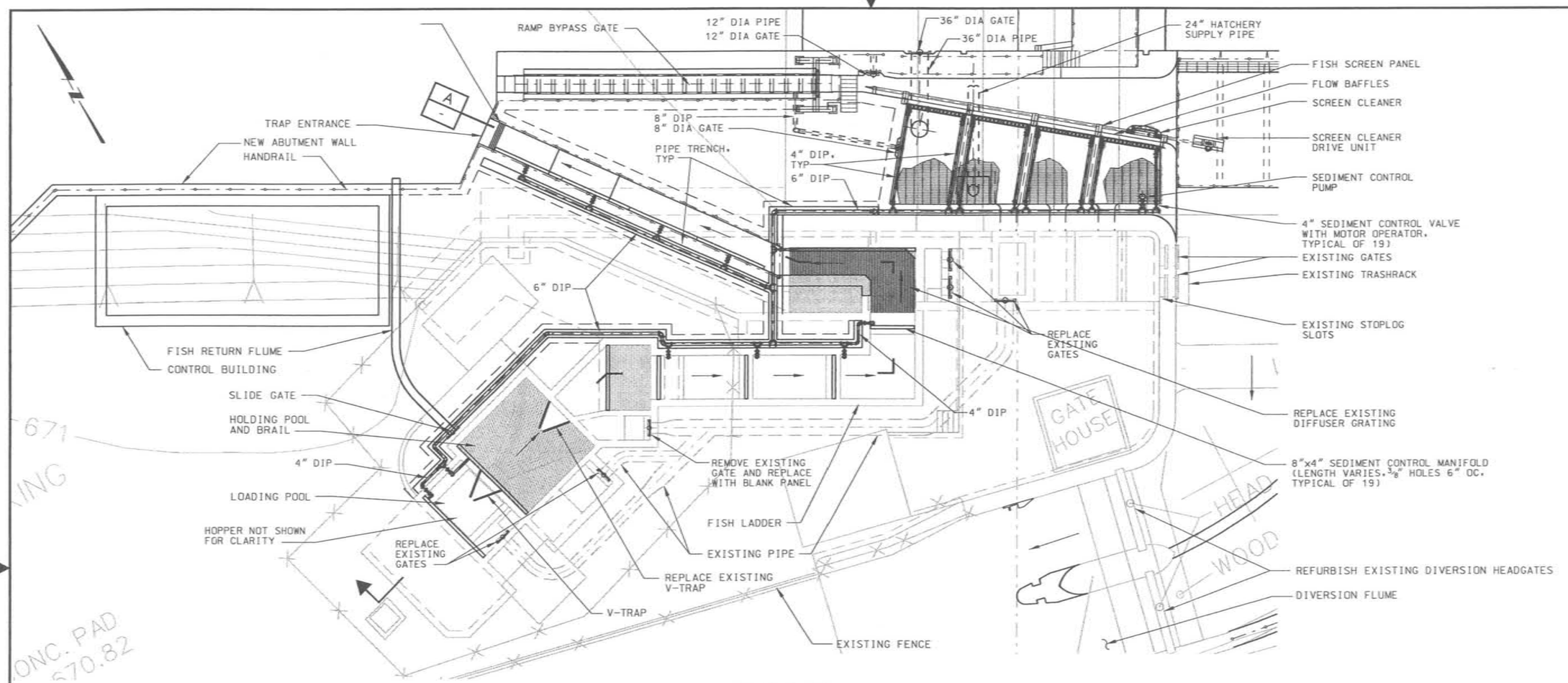
LOCALLY PREFERRED ALTERNATIVE
INTAKE SECTIONS AND DETAILS 2

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		16

DSGN: F.E.P. | CHK: D.E.D. | SHEET 16 OF 41

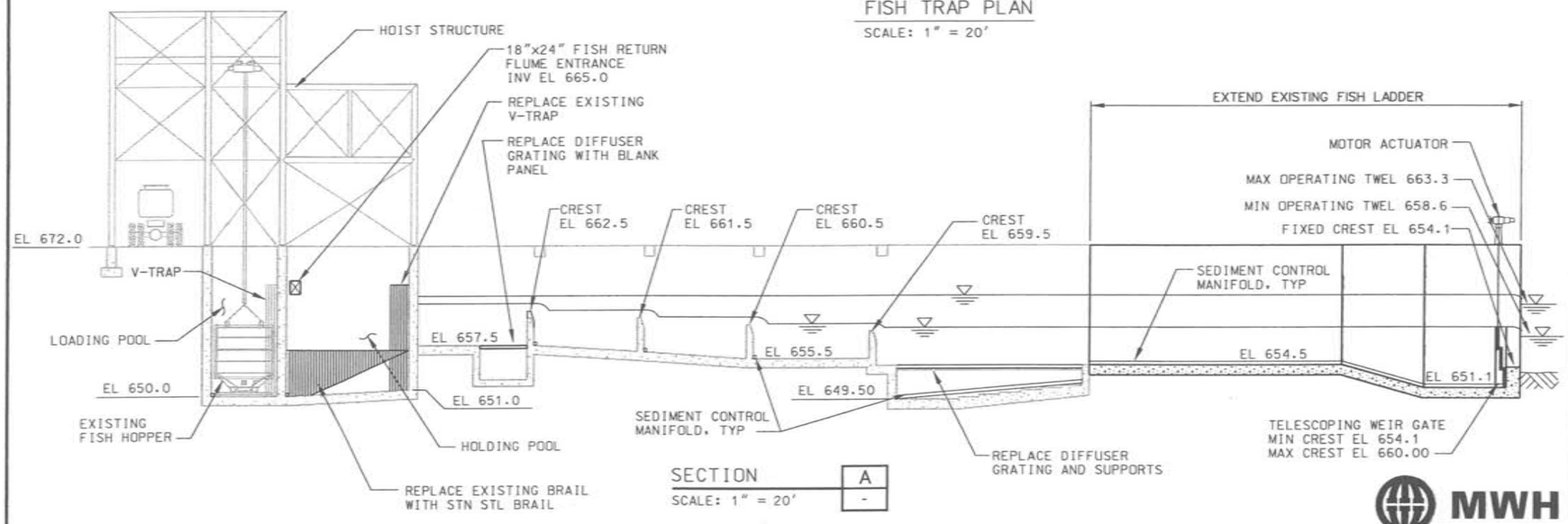
MWH

DESIGN FILE: \\Usseat1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate16.dgnDATE AND TIME PLOTTED: 30-DEC-2004 13:20



FISH TRAP PLAN

SCALE: 1" = 20'



SECTION A

SCALE: 1" = 20'

MWH

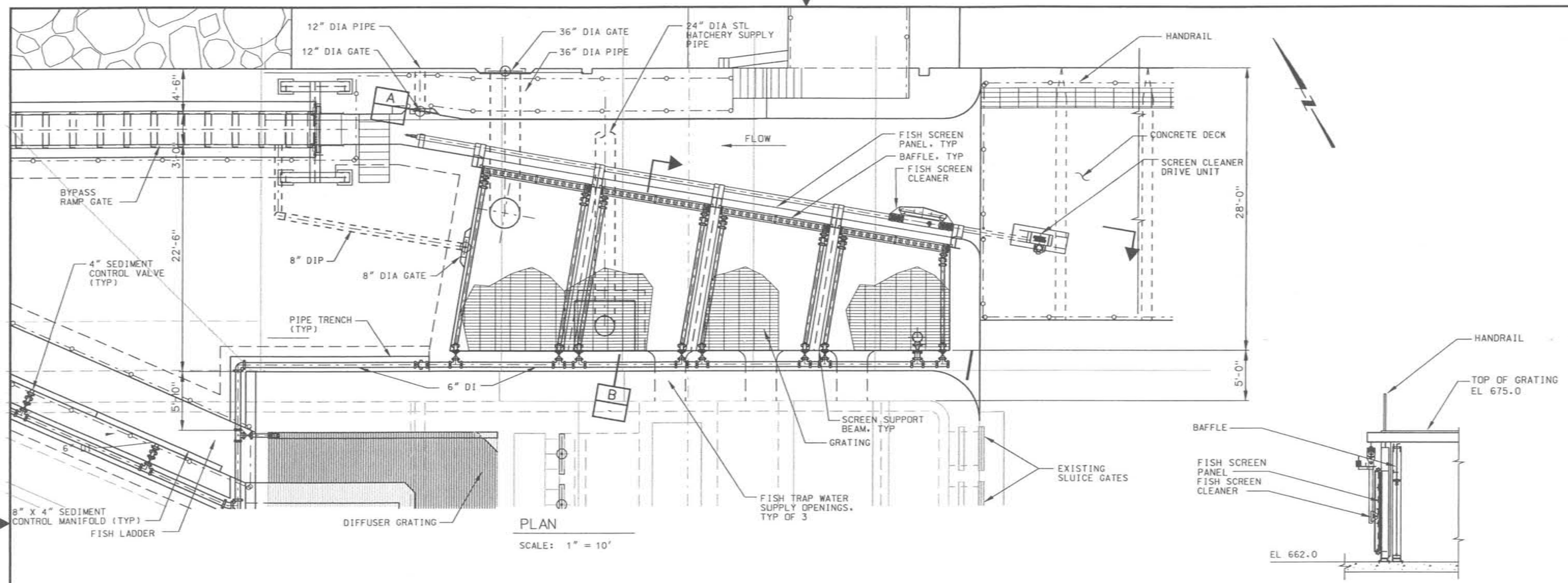
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
FISH TRAP
PLAN AND ELEVATION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		17

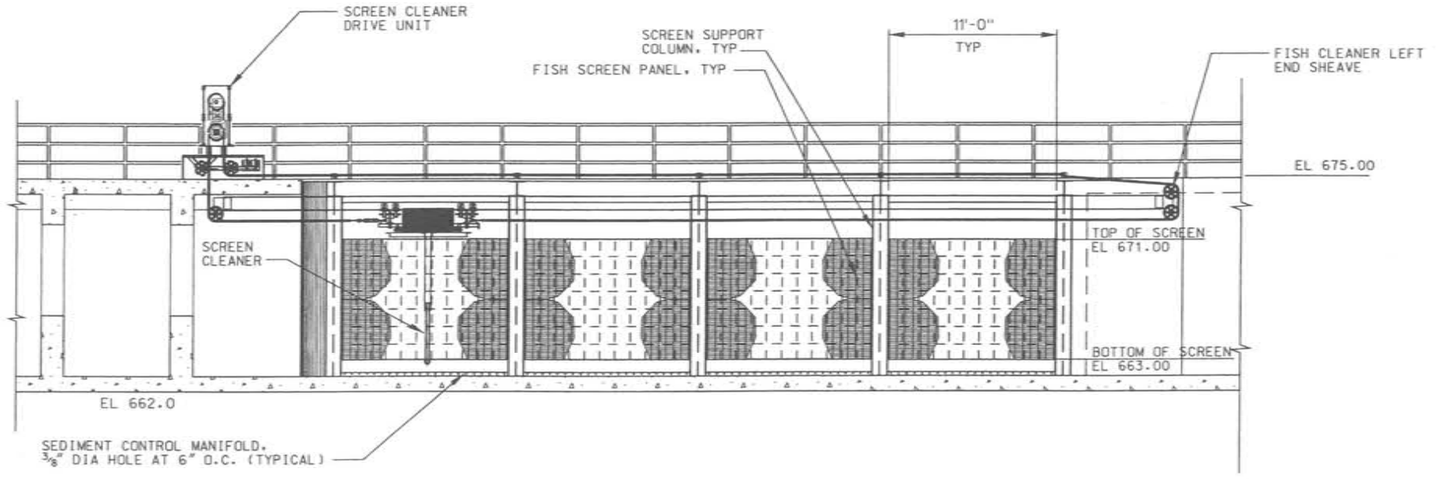
DSGN: F.E.P. | CHK: D.E.D. | SHEET 17 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate17.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:20



PLAN

SCALE: 1" = 10'



SECTION A

SCALE: 1" = 10'

SECTION B

SCALE: 1" = 10'

MWH

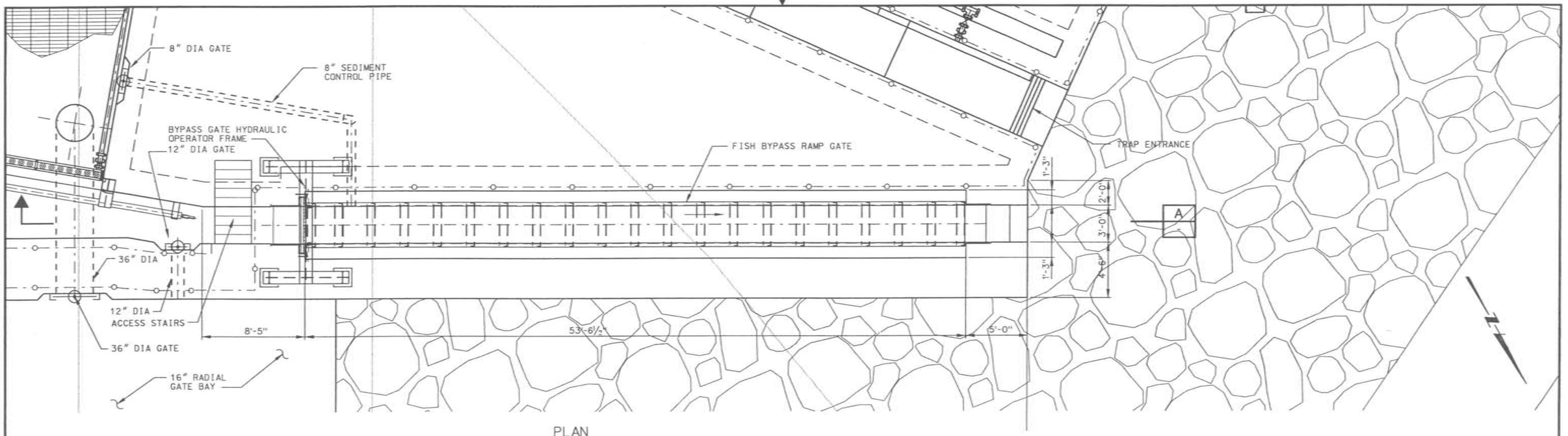
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
FISH SCREEN
PLAN AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	—		18

DSGN: F.E.P. | CHK: D.E.D. | SHEET 18 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate18.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:20



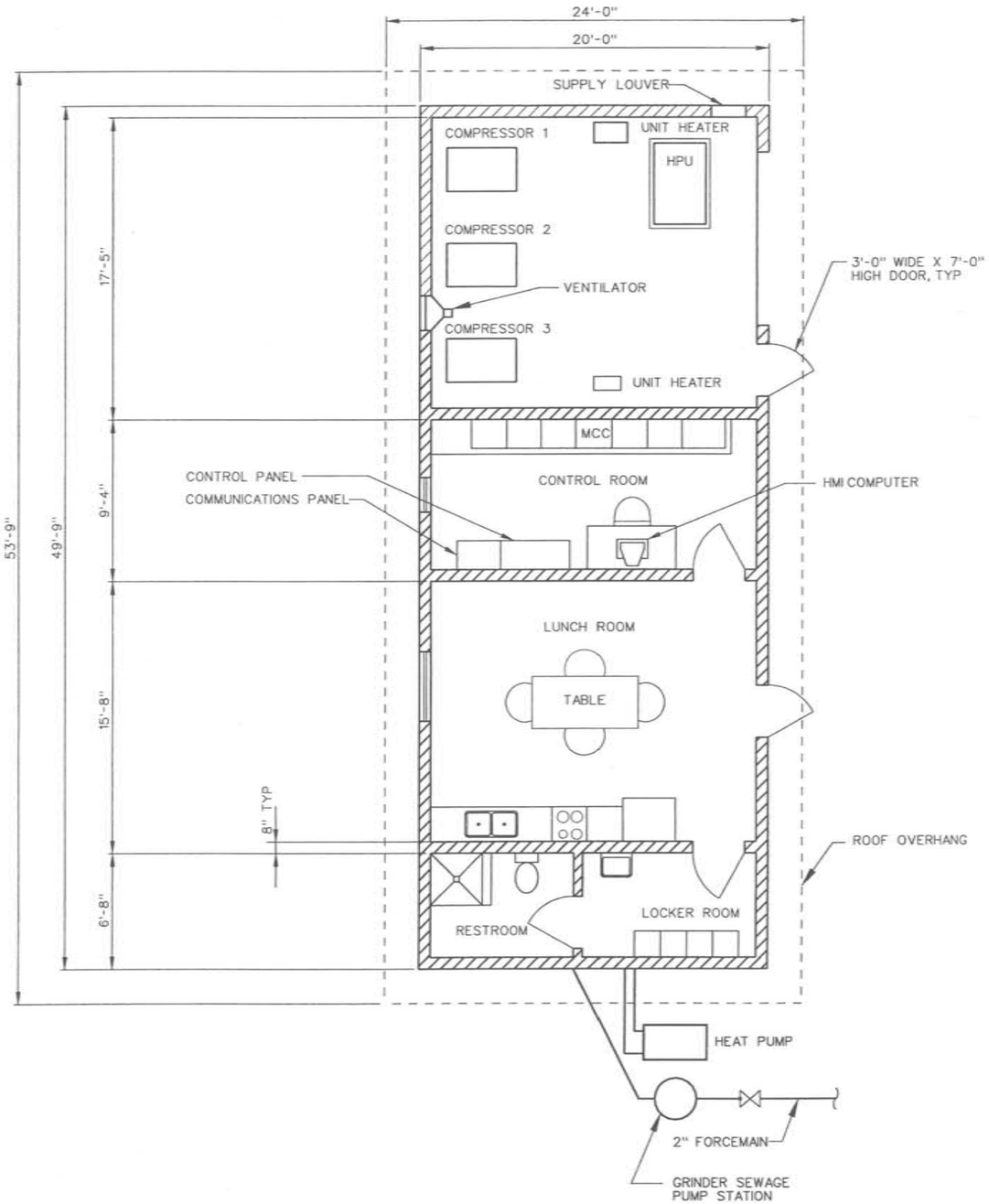
PLAN

SCALE: 1/8" = 1'-0"

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON			
MUD MOUNTAIN DAM FISH PASSAGE INVESTIGATION **LOCALLY PREFERRED ALTERNATIVE** **BYPASS RAMP GATE** **PLAN AND SECTION**			
SIZE B	INVITATION NO. ———	FILE NO.	PLATE 19
DSGN: F.E.P.	CHK: D.E.D.	SHEET 19 OF 41	

DESIGN FILE: \\Usseat1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate19.dgnDATE AND TIME PLOTTED: 30-DEC-2004 13:20



PLAN
SCALE: 1/8" = 1'-0"

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

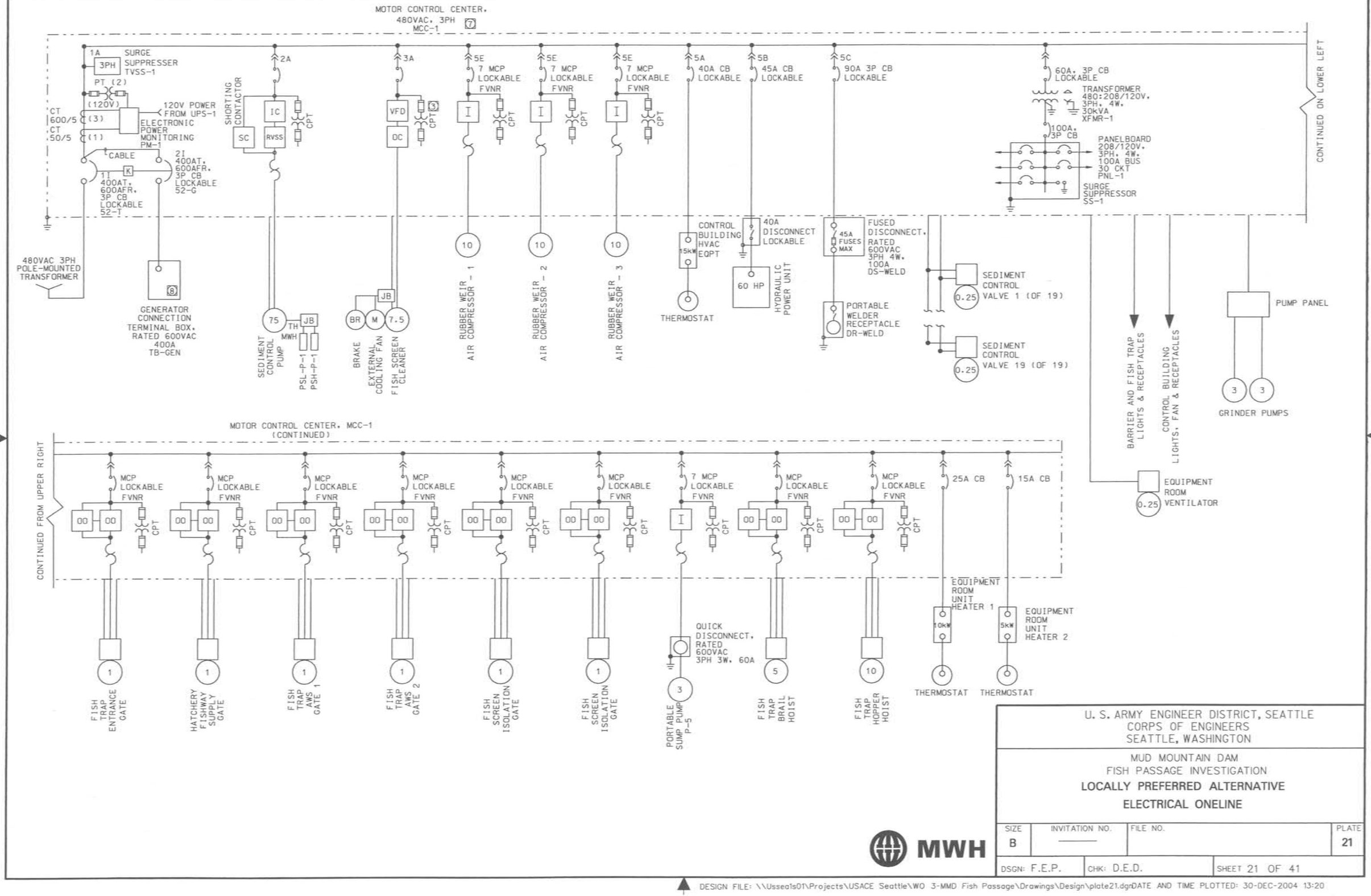
LOCALLY PREFERRED ALTERNATIVE

CONTROL BUILDING PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		20

DSGN: F.E.P.	CHK: D.E.D.	SHEET 20 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate20.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:20



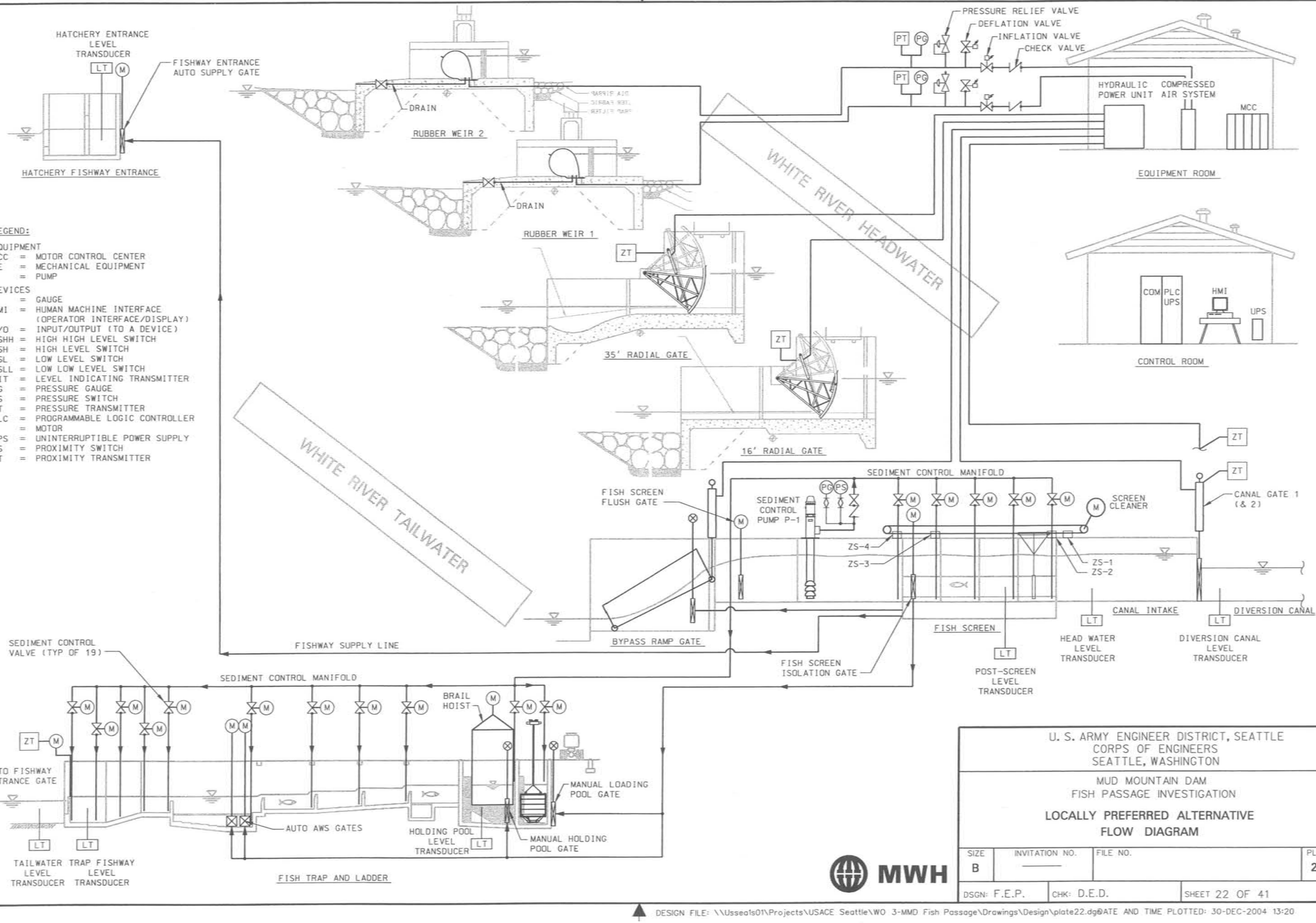
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
LOCALLY PREFERRED ALTERNATIVE
ELECTRICAL ONELINE

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		21

DSGN: F.E.P. | CHK: D.E.D. | SHEET 21 OF 41

MWH



LEGEND:

EQUIPMENT
- MCC = MOTOR CONTROL CENTER
- ME = MECHANICAL EQUIPMENT
- P = PUMP

DEVICES
- G = GAUGE
- HMI = HUMAN MACHINE INTERFACE (OPERATOR INTERFACE/DISPLAY)
- I/O = INPUT/OUTPUT (TO A DEVICE)
- LSHH = HIGH HIGH LEVEL SWITCH
- LSH = HIGH LEVEL SWITCH
- LSL = LOW LEVEL SWITCH
- LSLL = LOW LOW LEVEL SWITCH
- LIT = LEVEL INDICATING TRANSMITTER
- PG = PRESSURE GAUGE
- PS = PRESSURE SWITCH
- PT = PRESSURE TRANSMITTER
- PLC = PROGRAMMABLE LOGIC CONTROLLER
- M = MOTOR
- UPS = UNINTERRUPTIBLE POWER SUPPLY
- ZS = PROXIMITY SWITCH
- ZT = PROXIMITY TRANSMITTER

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

LOCALLY PREFERRED ALTERNATIVE FLOW DIAGRAM

SIZE	INVITATION NO.	FILE NO.	PLATE
B	—		22
DSGN: F.E.P.	CHK: D.E.D.	SHEET 22 OF 41	

DESIGN FILE: \\Usseatls01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate22.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:20

TEMPORARY CONSTRUCTION EASEMENT

PROJECT PROPERTY LIMITS

RIGHT BANK LEVEE, 60' WIDE EASEMENT

WHITE RIVER

KING COUNTY / PIERCE COUNTY

T.O.W. EL 678.0

SLAB EL 664.0

BACKFILL AND SURFACE WITH CRUSHED ROCK UP TO CONCRETE WALLS

TOP OF WALL EL 678.0

TOP OF DIVIDER WALL EL 674.0

CONCRETE DECK

UPSTREAM LIMIT OF EXISTING BARRIER

FISH SCREEN FACILITIES

16' RADIAL GATE

JIB CRANE

CONCRETE WALLS

PSE DIVERSION FLUME

OGEE WEIR

BARRIER APRON

HATCHERY FISHTRAP

HATCHERY FISHWAY

DOWNSTREAM LIMITS OF EXISTING BARRIER

HATCHERY FISHWAY ENTRANCE

BYPASS RAMP GATE

FISH TRAP ENTRANCE

LOADING POOL

HOLDING POOL

FISH TRAP LADDER

CONTROL BUILDING

NOTES:
1 IN GENERAL THE FEDERAL ALTERNATIVE IS BASED ON THE ASSUMPTION THAT NO DIVERSION WILL OCCUR AT THE PSE INTAKE. HOWEVER, IF A DIVERSION IS REQUIRED, A "DIVERSION OPTION" IS PRESENTED ON THE INSERT. FOR COST COMPARISON PURPOSES, INTAKE FEATURES ASSOCIATED EXCLUSIVELY WITH THE DIVERSION ARE EXCLUDED FROM THE FEDERAL ALTERNATIVE COST.

OVERALL SITE PLAN

SCALE: 1"=50'

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

TOW EL 666.0

FEATURES EXCLUDED FROM FEDERAL COSTS

TOW EL 674.0

EXTENDED WALL

DIVERSION OPTION

SEE NOTE 1

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

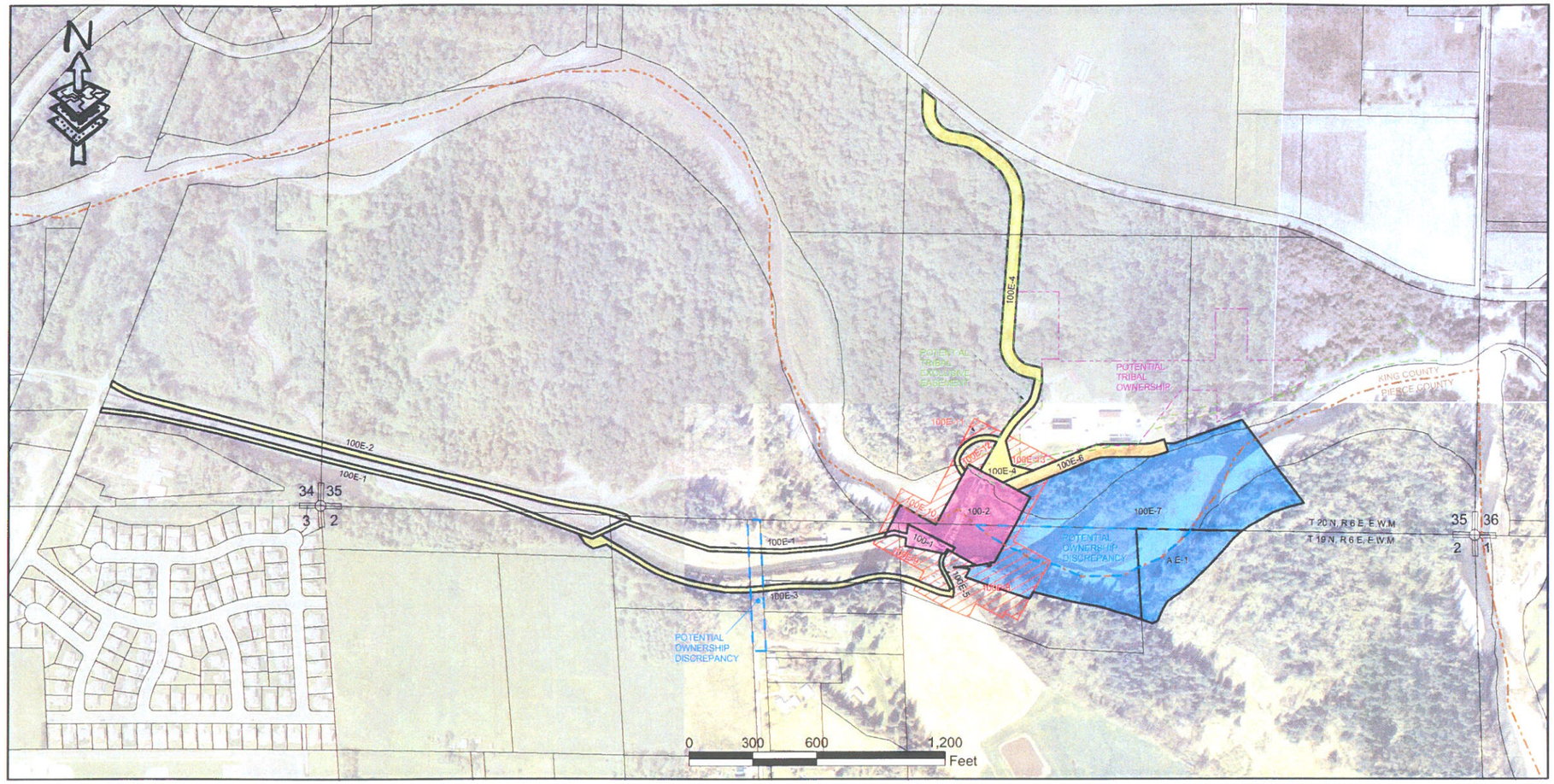
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
OVERALL SITE PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B			23

DSGN: F.E.P. | CHK: D.E.D. | SHEET 23 OF 41

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate23.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:20



LEGEND:

- COUNTY BOUNDARY
- POTENTIAL OWNERSHIP DISCREPANCY
- POTENTIAL TRIBAL OWNERSHIP
- POTENTIAL TRIBAL EXCL. ESMNT
- PARCELS
- TEMP. CONSTRUCTION EASEMENT
- FEE
- LEVEE EASEMENT
- FLOWAGE EASEMENT
- BRIDGE EASEMENT
- ROAD EASEMENT

SOURCE

1 BASED ON PROPERTY AND EASEMENT PLAN IN DESIGN PLATES OF FEDERAL PREFERRED ALTERNATIVE (FPA) ELECTRONIC DESIGN FILES FURNISHED BY MWH TO REAL ESTATE IN MARCH 2004 (PLATES 1-41) AND SEPTEMBER 2004 (PLATES 4-1 TO 4-4).

2 ALSO BASED ON MODIFICATIONS AND INPUT FROM PLANNING BRANCH, CIVIL PROJECT BRANCH, HYDRAULICS & HYDROLOGY SECTION, AND GEOLOGY & INSTRUMENTATION SECTION WITHIN THE SEATTLE DISTRICT OF USACE.

3. PARCEL OWNER INFORMATION BASED ON GIS DATA FROM KING AND PIERCE COUNTIES, METROSCAN, AND FIRST AMERICAN TITLE INSURANCE COMPANY

4. AERIAL ORTHOPHOTOS WAS AQCUIRED FROM TRIATHLON INC. AND ORIGINATE FROM 1998 (SOUTHEAST CORNER) AND 2002.

DISCLAIMER

THIS MAP IS BASED ON BEST AVAILABLE INFORMATION AT THE DATE INDICATED BELOW. OWNERSHIPS, PROPERTY BOUNDARIES, AND OTHER INPUT DATA ARE SUBJECT TO CONTINUING CHANGES. NO GUARANTEE OF ACCURACY IS GIVEN OR IMPLIED.

TABLE OF PROPOSED TRACTS

SYMBOL	TRACT ID	ESTATE	ACREAGE	OWNER	REMARKS
	100-1	FEE	0.40	PUGET SOUND ENERGY & ELECTR.	FEE SUBJECT TO EXISTING ACOE EASEMENT*
	100-2	FEE	3.23	PUGET SOUND ENERGY & ELECTR.	FEE WITH IMPROVEMENTS
	100E-2	EASEMENT	1.44	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-3	EASEMENT	1.09	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-4	EASEMENT	3.17	PUGET SOUND ENERGY & ELECTR.	ROAD EASEMENT
	100E-5	EASEMENT	0.08	PUGET SOUND ENERGY & ELECTR.	BRIDGE EASEMENT
	100E-6	EASEMENT	1.05	PUGET SOUND ENERGY & ELECTR.	LEVEE EASEMENT
	100E-7	EASEMENT	15.34	PUGET SOUND ENERGY & ELECTR.	PERMANENT FLOWAGE EASEMENT
	A E-1	EASEMENT	2.75	WASH. STATE DEPT. SOCIAL SVCS.	PERMANENT FLOWAGE EASEMENT
	100E-8	EASEMENT	3.03	PUGET SOUND ENERGY & ELECTR.	TEMP. CONSTR. EASEMENT, 1.60 ACS INCLUDED IN 100E-7
	100E-9	EASEMENT	0.78	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-10	EASEMENT	0.81	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-11	EASEMENT	0.21	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-12	EASEMENT	0.34	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
	100E-13	EASEMENT	0.44	PUGET SOUND ENERGY & ELECTR.	TEMPORARY CONSTRUCTION EASEMENT
		GROSS TOTAL	**34.16**	(NET TOTAL **32.56** ACS AFTER DEDUCTING OVERLAPPING AREA WITHIN TRACT 100E-8)	

SUMMARY TABLE OF PROPOSED ACQUISITION

SYMBOL	OWNER	ESTATE	REMARKS	ACREAGE
	PUGET SOUND ENERGY & ELECTR.	FEE	FEE SUBJECT TO EXISTING ACOE EASEMENT*	0.40
	PUGET SOUND ENERGY & ELECTR.	FEE	FEE WITH IMPROVEMENTS	3.23
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	ROAD EASEMENTS	5.70
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	LEVEE EASEMENTS	1.05
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	BRIDGE EASEMENTS	0.08
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	PERMANENT FLOWAGE EASEMENTS	15.34
	WASH. STATE DEPT. SOCIAL SVCS.	EASEMENT	PERMANENT FLOWAGE EASEMENTS	2.75
	PUGET SOUND ENERGY & ELECTR.	EASEMENT	TEMPORARY CONSTRUCTION EASEMENTS	5.61
			TOTAL	**34.16**

TABLE OF EXISTING TRACTS

SYMBOL	Tract ID	Estate	Acreage	Owner	Remarks
	100E-1	EASEMENT	1.74	PUGET SOUND ENERGY & ELECTR.	EXISTING EASEMENT*

* CURRENT TRACT B100E FOR ROAD R/W AND FISH FACILITIES (DEED 22 MAY 1950)

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U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

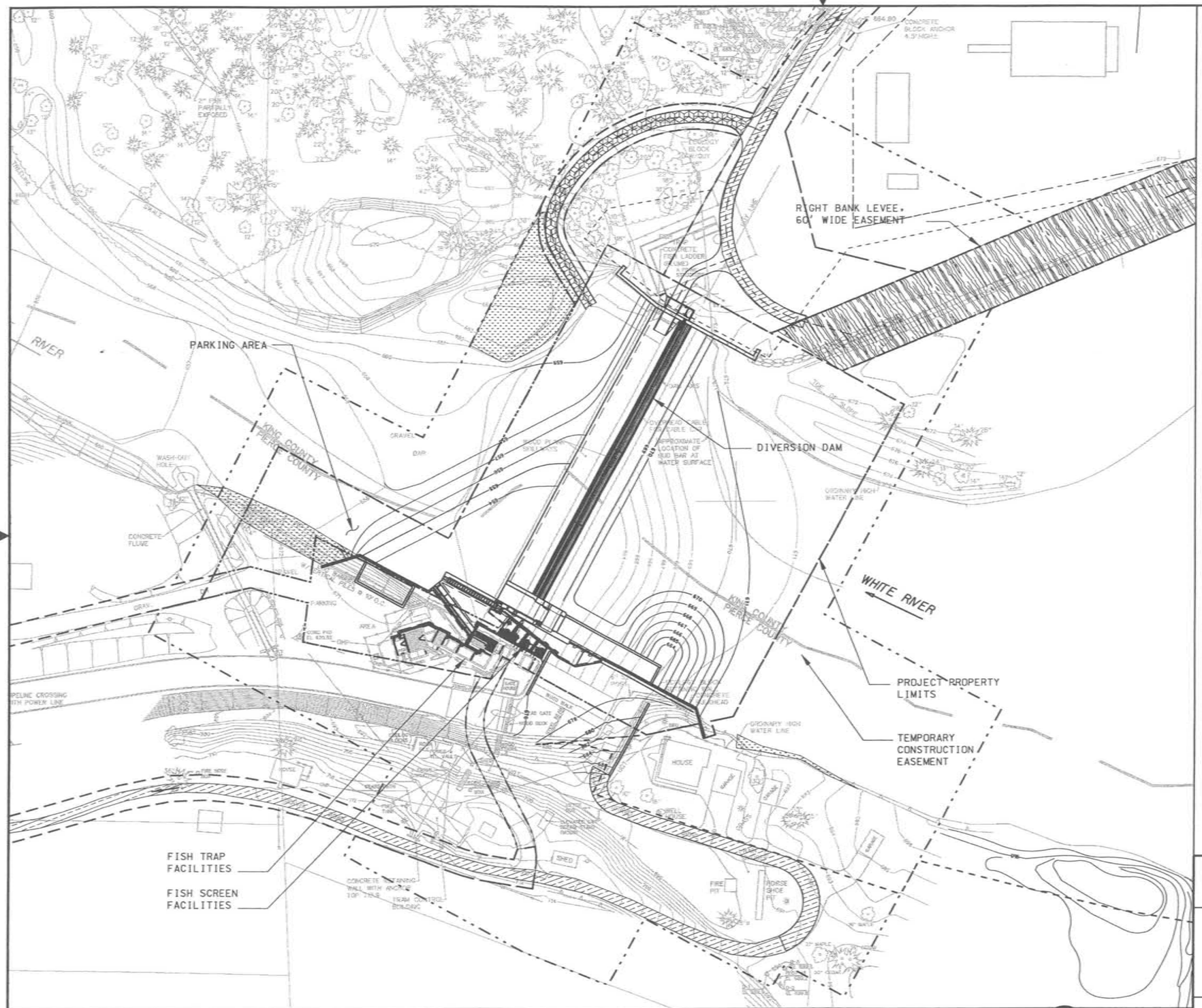
LOCALLY PREFERRED ALTERNATIVE PROPERTY AND EASEMENT PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B			24

DSGN: F.E.P. | CHK: D.E.D. | SHEET 24 OF 41

DESIGN FILE: $$$$$$$$$$$$$$$$$$directory/filename$$$$$$$$$$$$$$$$$$

DATE AND TIME PLOTTED: $$$$date$$$$



DIVERSION DAM AND TRAP FACILITIES ENLARGEMENT PLAN

SCALE: 1" = 100'

MWH

N

LEGEND:

- PROJECT PROPERTY LIMITS
- TEMPORARY CONSTRUCTION EASEMENT
- ACCESS AND LEVEE EASEMENTS

VEGETATION PLAN LEGEND:

A: RE-PLANT DISTURBED ROAD EASEMENT
VINE MAPLE (ACER CIRCINATUM)
SALMONBERRY (RUBUS SPECTABILIS)
THIMBLEBERRY (RUBUS PARVIFLORUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)

B: DE-COMMISSION ACCESS ROAD/RE-PLANT
DOUGLAS-FIR (PSEUDOTSUGA MENZIESII)
WESTERN HEMLOCK (TSUGA HETEROPHYLLA)
BIG-LEAF MAPLE (ACER MACROPHYLLUM)
BLACK COTTONWOOD (POPULUS BALSAMIFERA)
VINE MAPLE (ACER CIRCINATUM)
SNOWBERRY (SYMPHORICARPOS ALBUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SWORD FERN (POLYSTICHUM MUNITUM)

C: PLANT LEVEE SLOPES/RIPARIAN-WILLOW
THIMBLEBERRY (RUBUS PARVIFLORUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SNOWBERRY (SYMPHORICARPOS ALBUS)
OCEANSPRAY (HOLODISCUS DISCOLOR)

D: INCIDENTAL DISTURBANCE/UPLAND PLANTING
DOUGLAS-FIR (PSEUDOTSUGA MENZIESII)
BIG-LEAF MAPLE (ACER MACROPHYLLUM)
VINE MAPLE (ACER CIRCINATUM)
SNOWBERRY (SYMPHORICARPOS ALBUS)
INDIAN PLUM (OEMELARIA CERASIFORMES)
RED ELDERBERRY (SAMBUCUS RACEMOSA)
SERVICEBERRY (AMELANCHIER ALNIFOLIA)
SWORD FERN (POLYSTICHUM MUNITUM)

CONTINUE

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

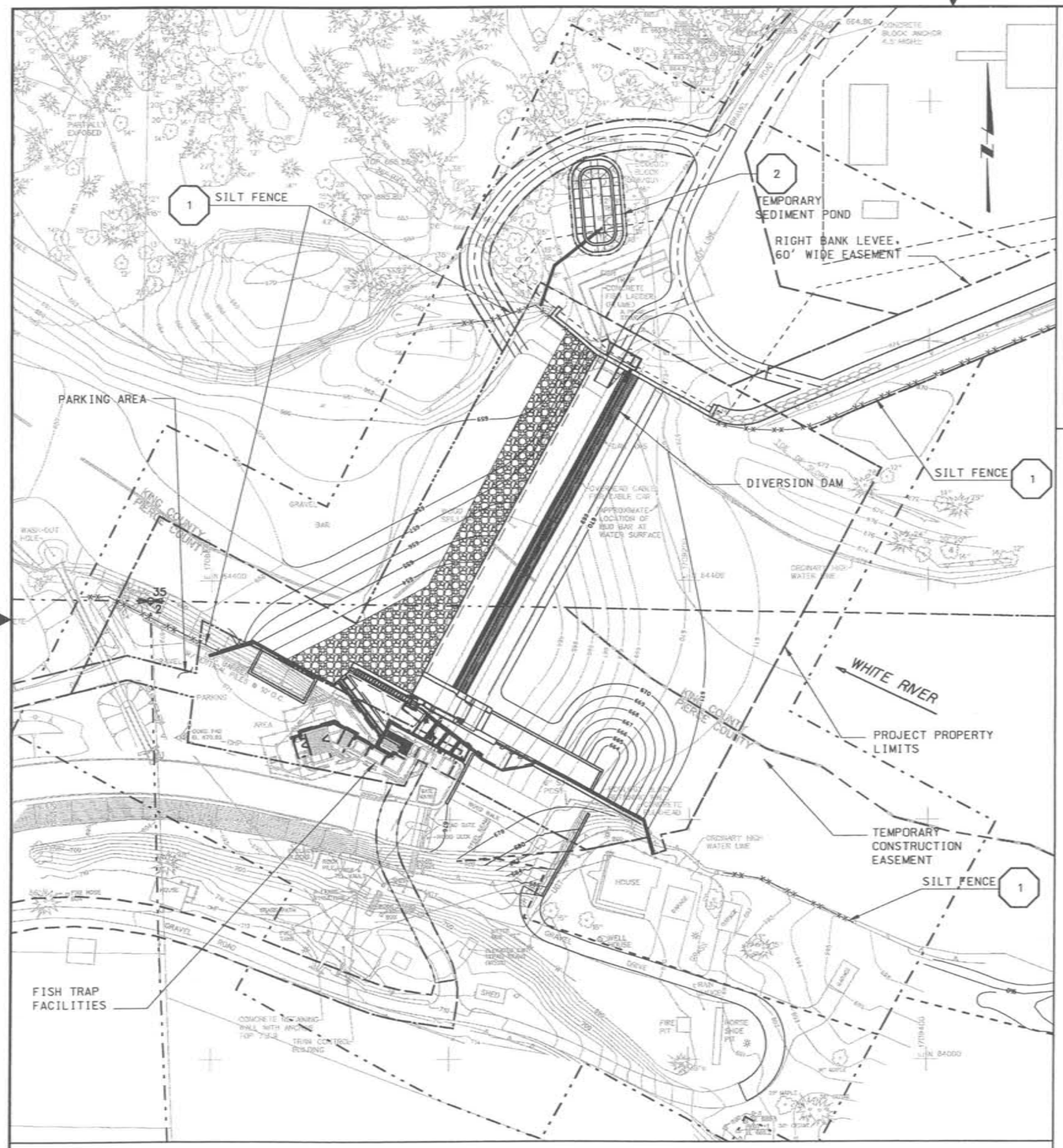
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
PROJECT FOOTPRINT AND PLANTING PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		25

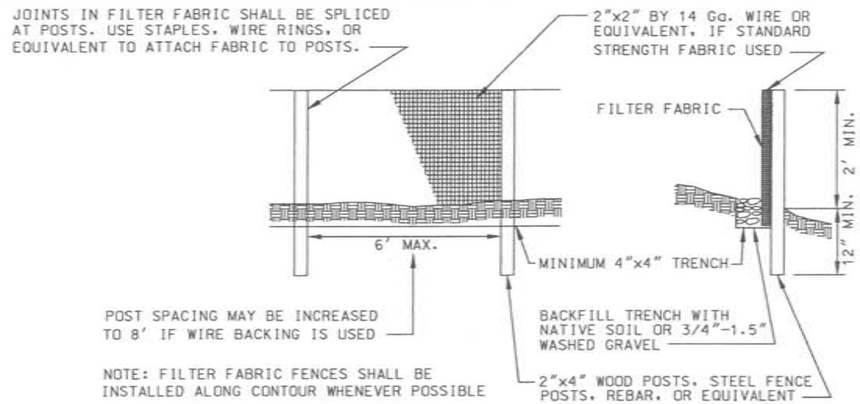
DSGN: F.E.P.	CHK: D.E.D.	SHEET 25 OF 41

DESIGN FILE: \\Ussea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate25.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



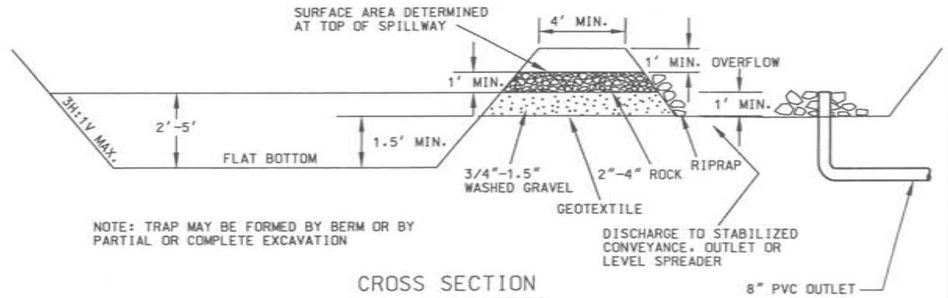
EROSION - SEDIMENT AND WATER CONTROL PLAN

SCALE: 1" = 100'



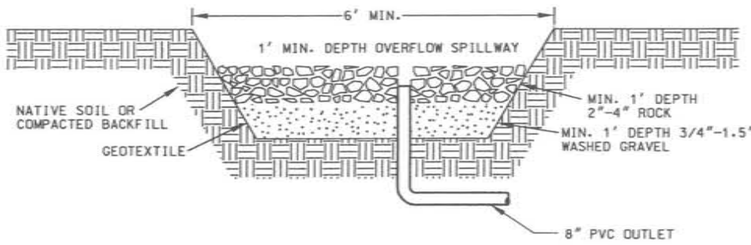
SILT FENCE 1

NOT TO SCALE



NOTE: TRAP MAY BE FORMED BY BERM OR BY PARTIAL OR COMPLETE EXCAVATION

CROSS SECTION



TEMPORARY SEDIMENT POND 2

NOT TO SCALE

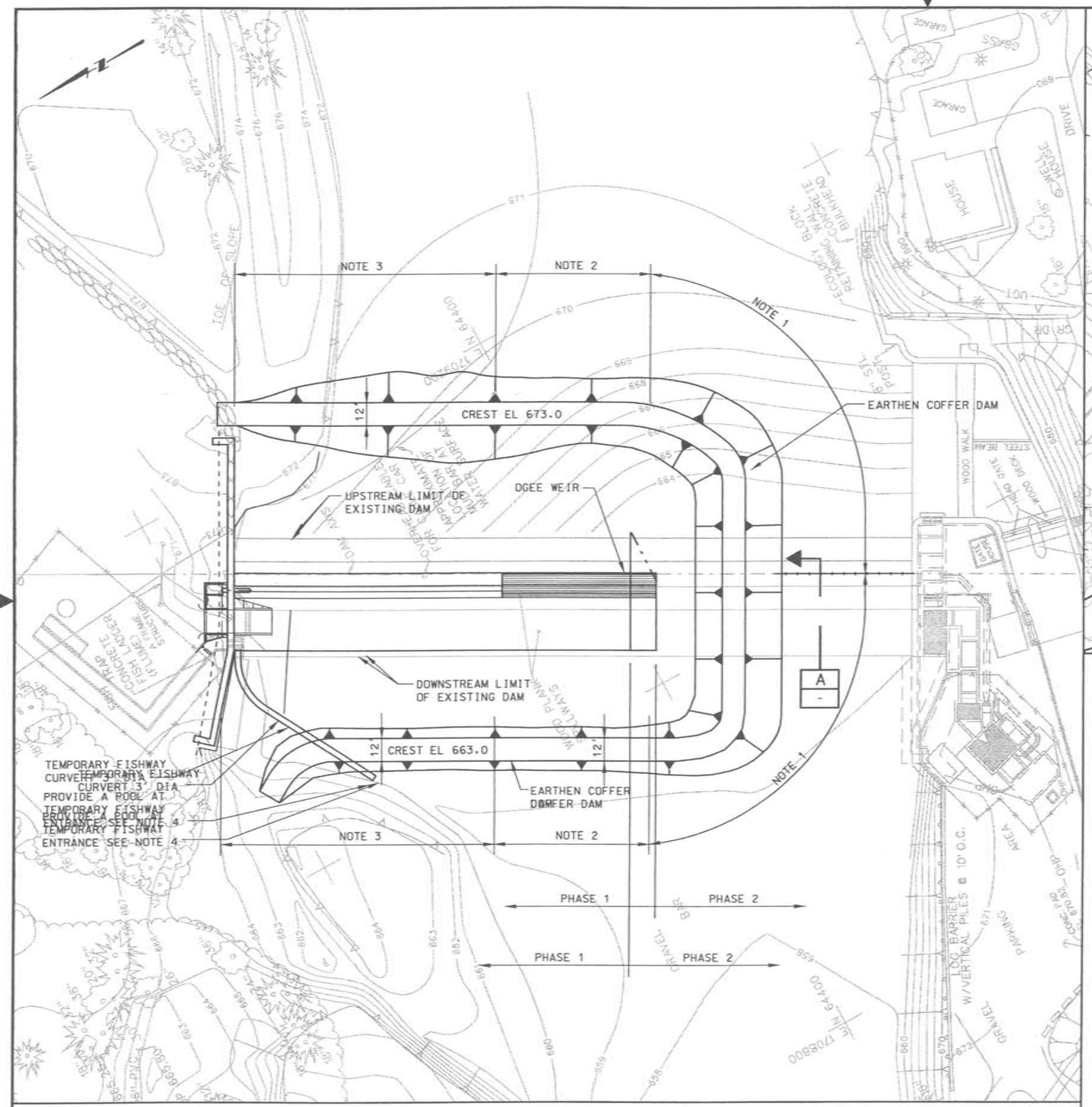
U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PREFERRED ALTERNATIVE
EROSION – SEDIMENT AND WATER CONTROL PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		26
DSGN: F.E.P.	CHK: D.E.D.	SHEET 26 OF 41	

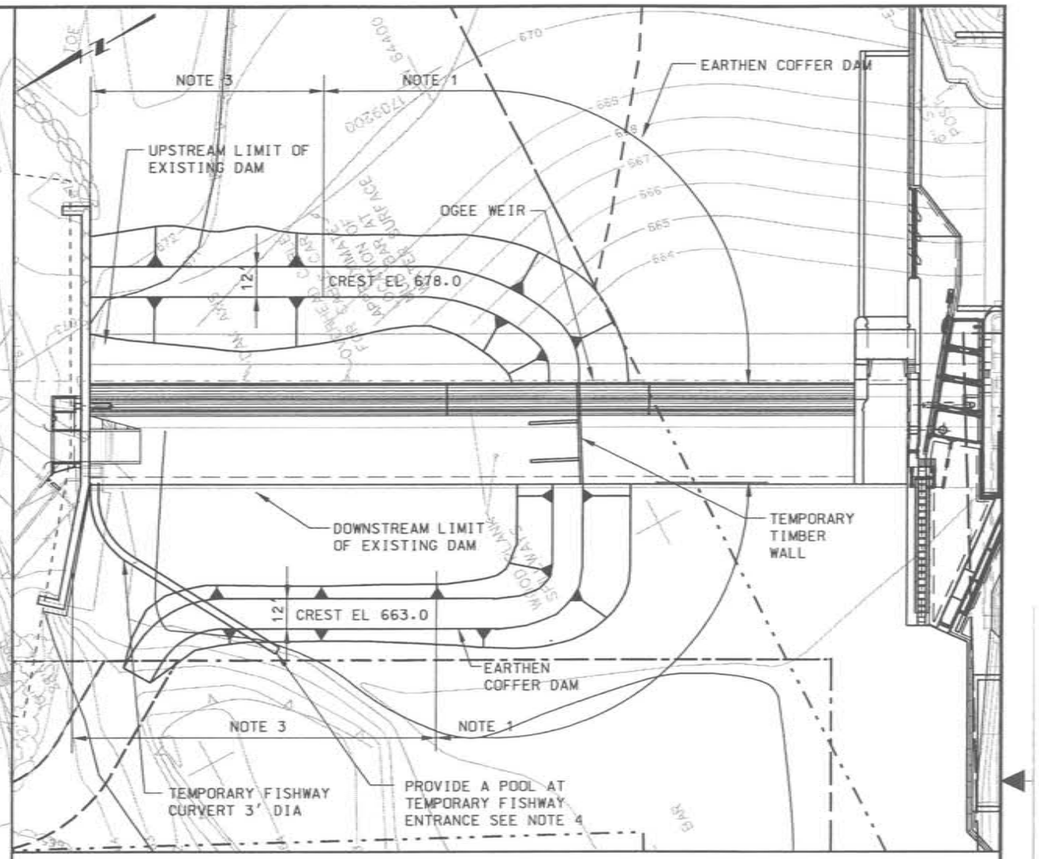
MWH

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate26.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



PHASE 1 COFFERDAM PLAN

SCALE: 1" = 60'



PHASE 3 COFFERDAM PLAN

SCALE: 1" = 60'

NOTES:

1 TYPE I COFFERDAM. SEE PLATE 28.

2 TYPE II COFFERDAM. SEE PLATE 28.

3 TYPE III COFFERDAM. SEE PLATE 28.

4 TEMPORARY FISHWAY CULVERT ENTRANCE TO BE SMOOTH, WITH A HEADWALL, AND NON-ERODABLE FOUNDATION.

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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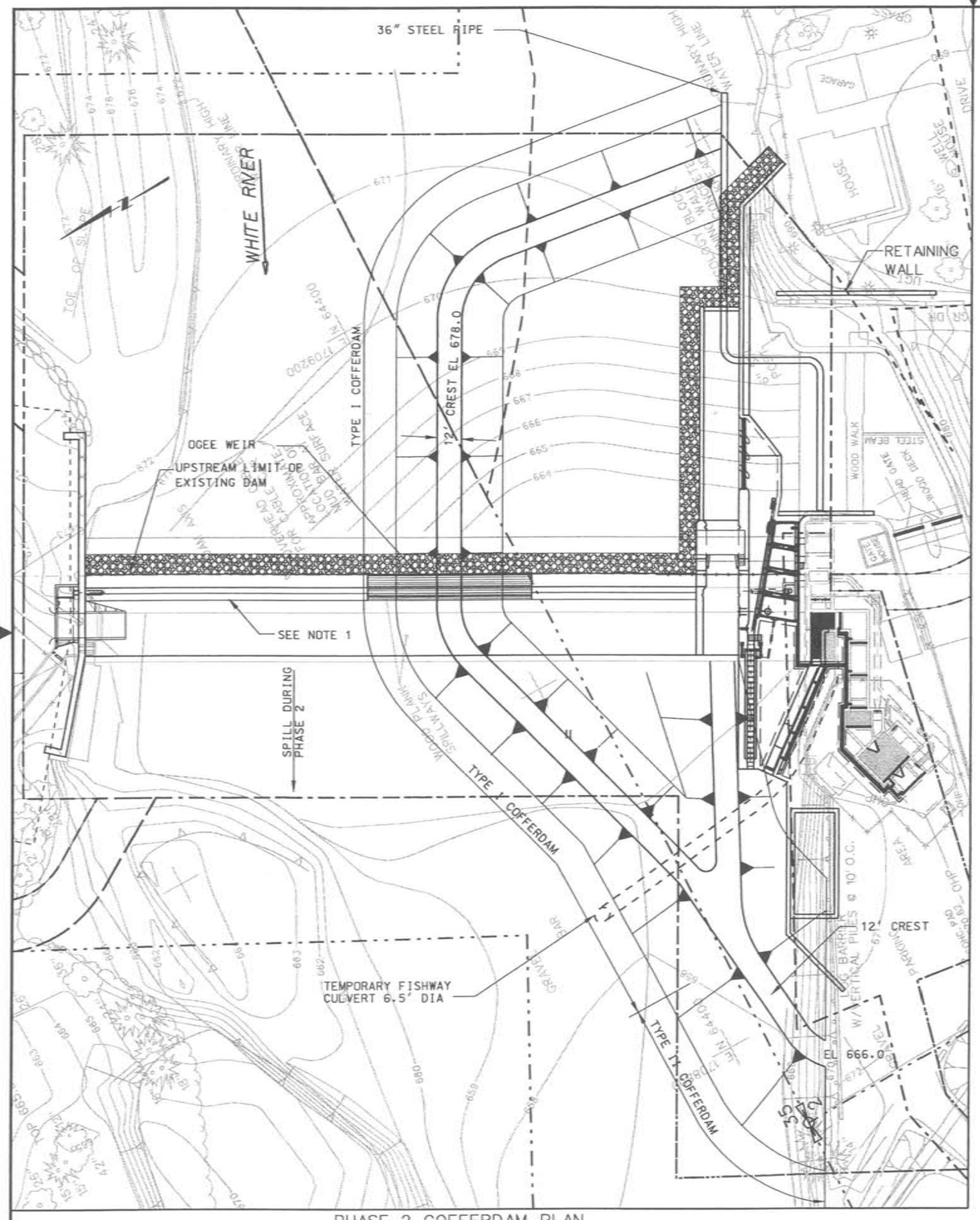
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PERFERRED ALTERNATIVE
PHASE 1 AND 3 COFFERDAM
PLAN AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		27

DSGN: F.E.P. | CHK: D.E.D. | SHEET 27 OF 41

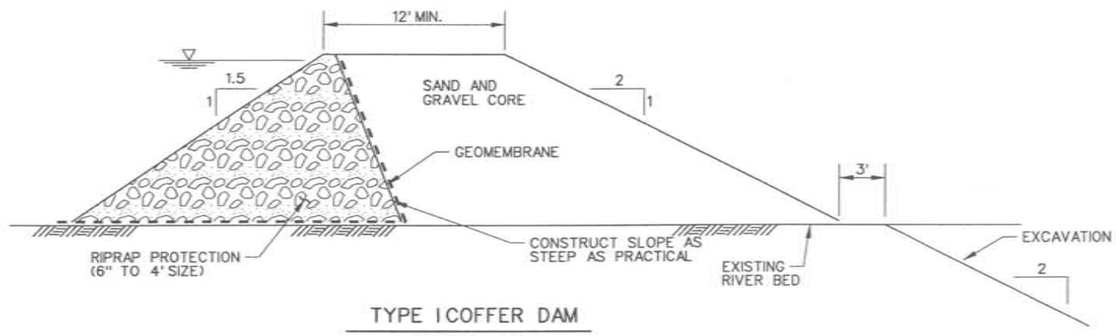
MWH

DESIGN FILE: \\Usseatls01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate27.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



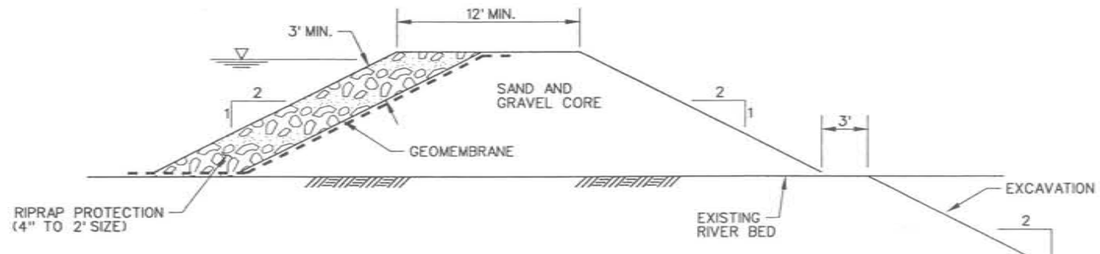
PHASE 2 COFFERDAM PLAN

SCALE: 1" = 60'



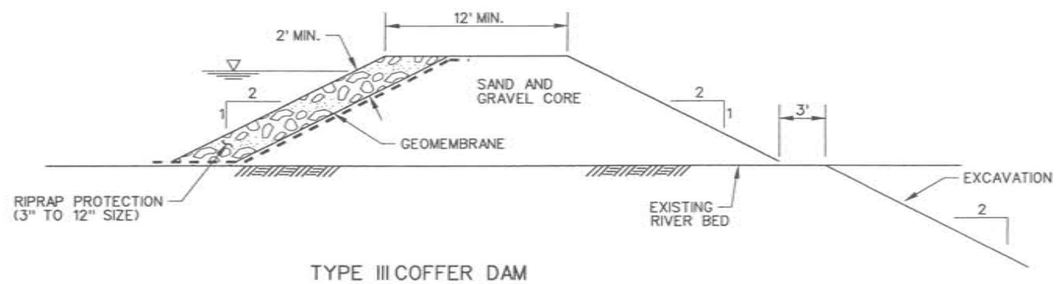
TYPE I COFFER DAM

SCALE: 1" = 10'



TYPE II COFFER DAM

SCALE: 1" = 10'



TYPE III COFFER DAM

SCALE: 1" = 10'

NOTES:

1 140 LF OF OGEE WIER WILL BE CONSTRUCTED DURING PHASE III AND A PHASE III COFFERDAM (NOT SHOWN) WILL BE CONSTRUCTED SIMILAR TO PHASE I.

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U. S. ARMY ENGINEER DISTRICT, SEATTLE
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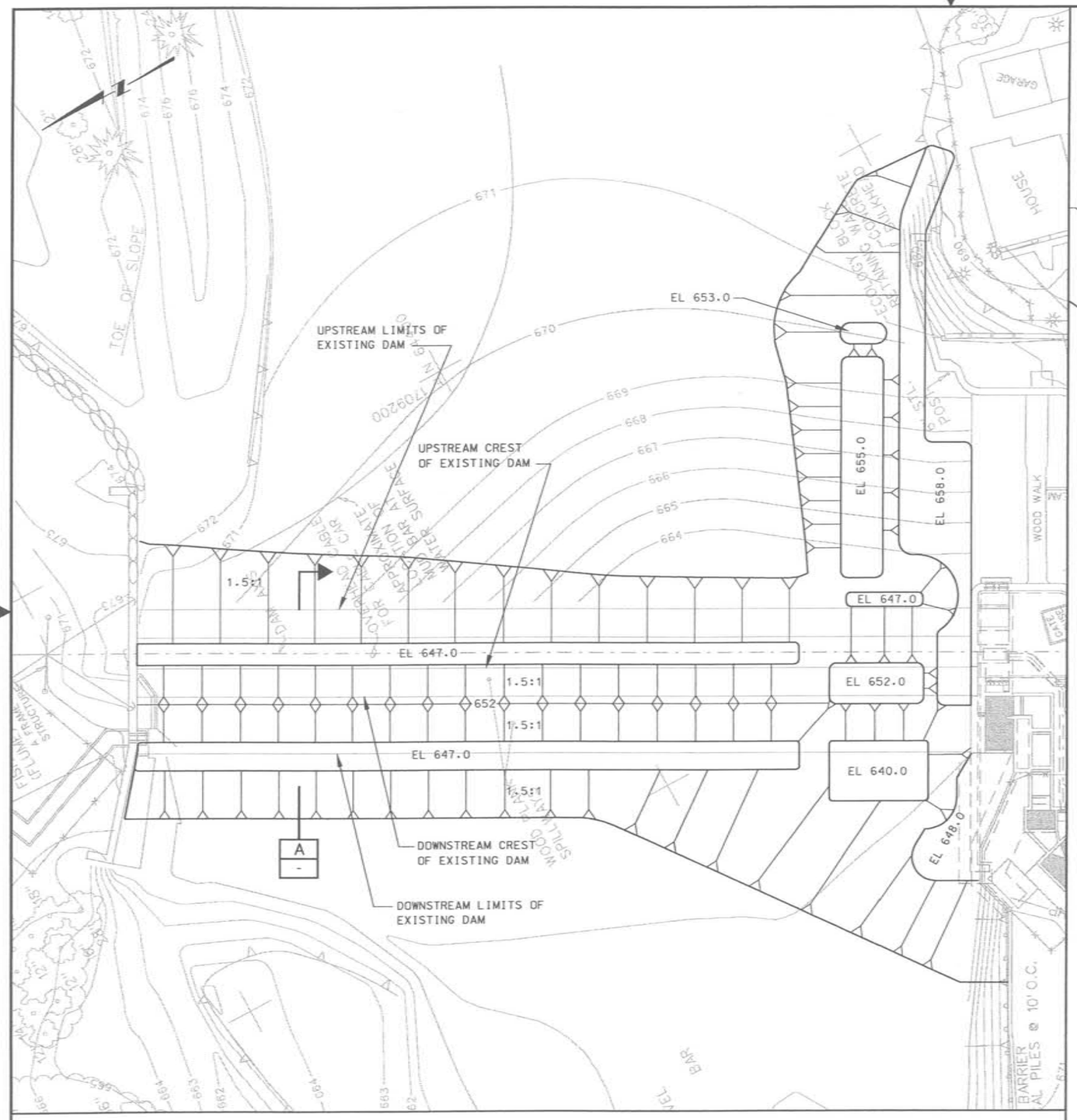
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
PHASE 2 COFFERDAM
PLAN AND SECTIONS

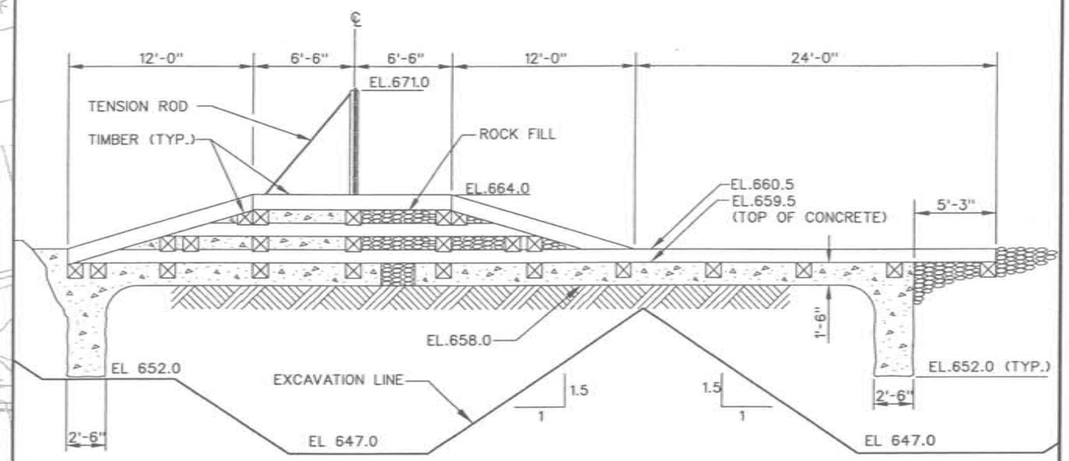
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		28
DSGN: F.E.P.	CHK: D.E.D.	SHEET 28 OF 41	

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate28.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



DAM FOUNDATION EXCAVATION PLAN

SCALE: 1" = 50'



EXISTING DAM SECTION

SCALE: 1" = 10'

A
-

NOTES:

1 EXISTING DAM DIMENSIONS ARE BASED ON THE ORIGINAL DAM DRAWINGS, DATED SEPT 29, 1910. CONTRACTOR SHALL VERIFY ALL DIMENSIONS.

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

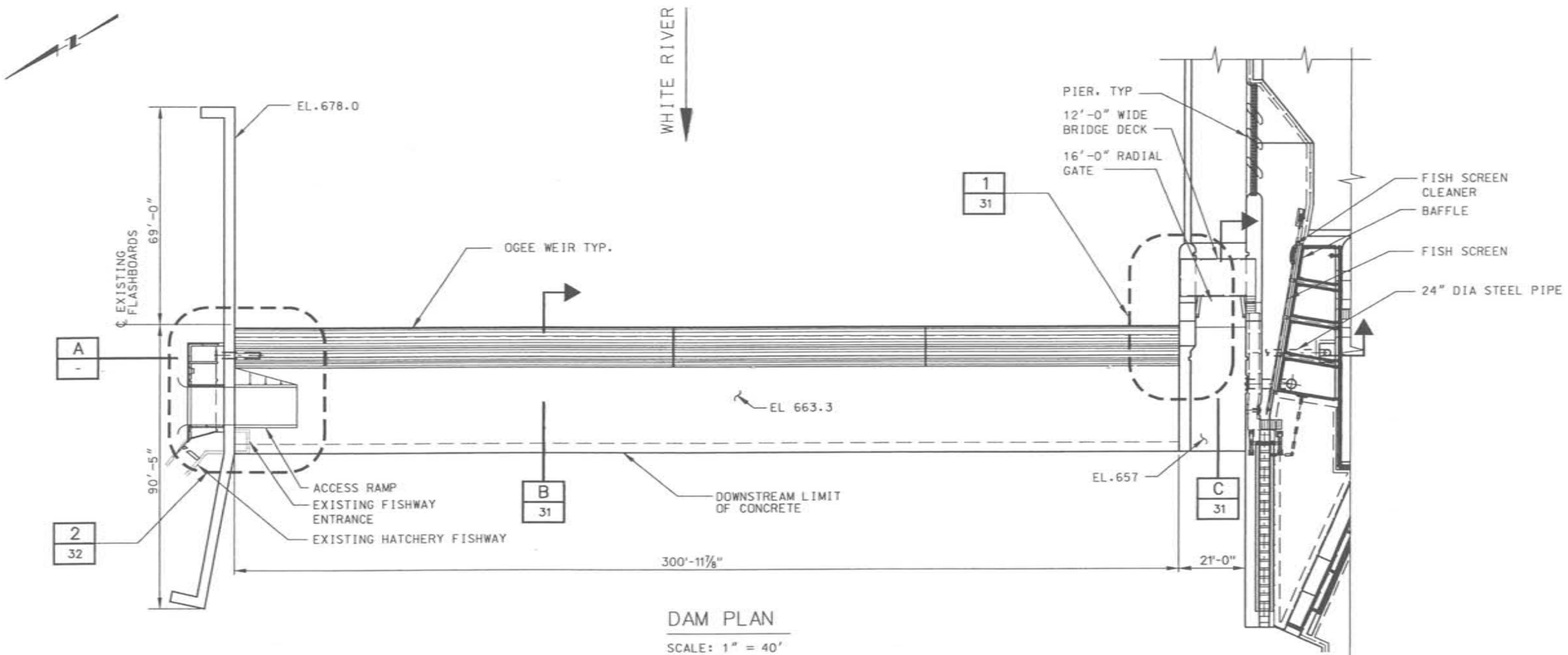
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
BARRIER DAM FOUNDATION EXCAVATION
PLAN AND SECTION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	—		29
DSGN: F.E.P.	CHK: D.E.D.	SHEET 29 OF 41	

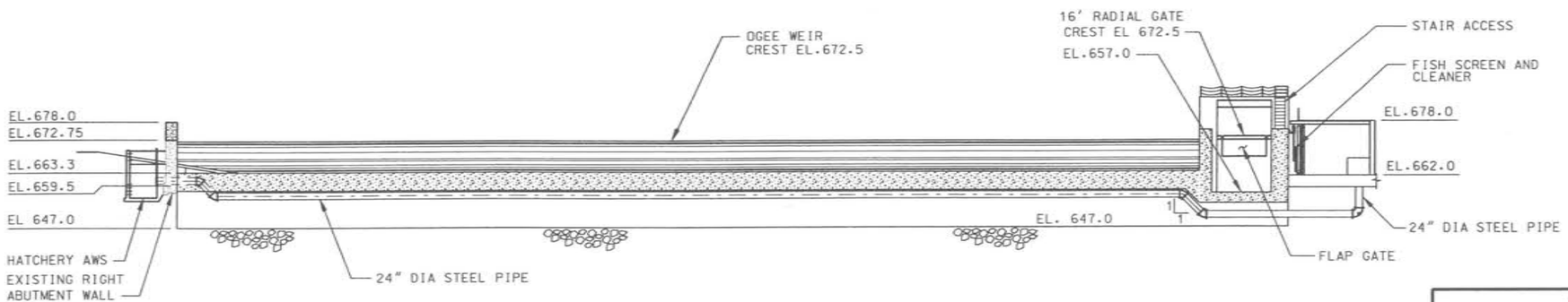
MWH

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate29.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



DAM PLAN

SCALE: 1" = 40'



DAM ELEVATION A

SCALE: 1" = 40'

U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

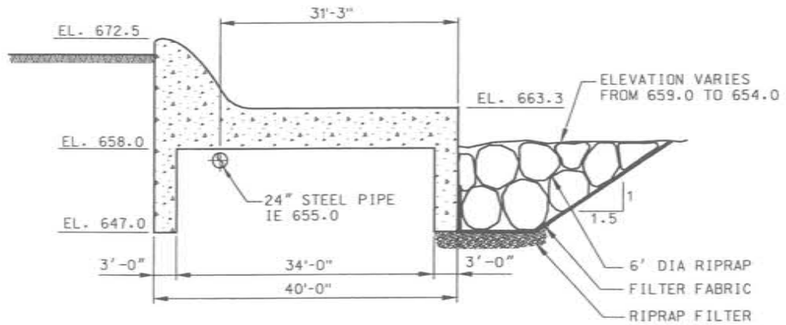
FEDERALLY PREFERRED ALTERNATIVE
DAM PLAN AND ELEVATION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		30

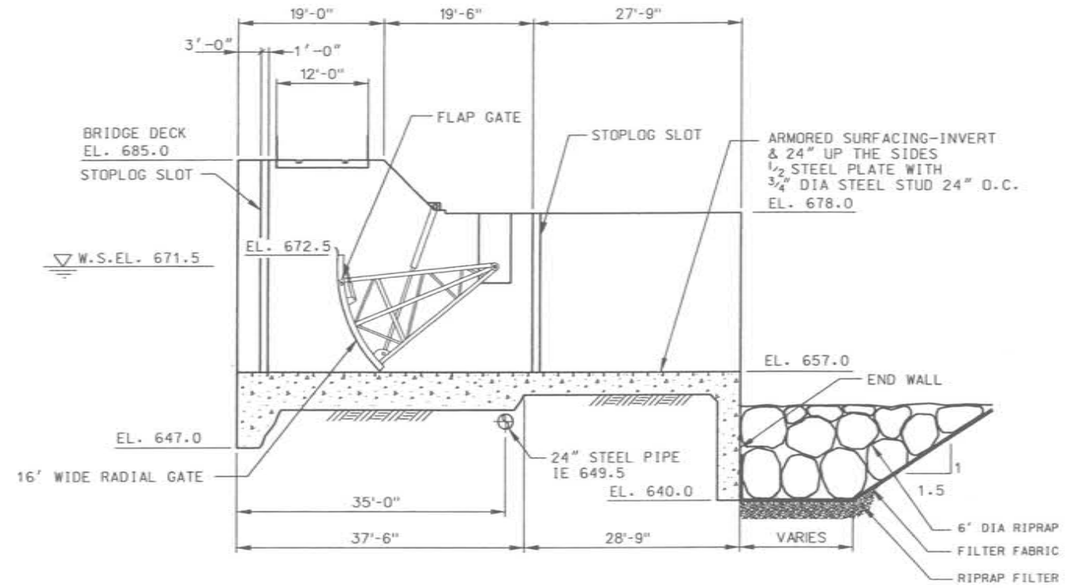
DSGN: F.E.P. | CHK: D.E.D. | SHEET OF 41

MWH

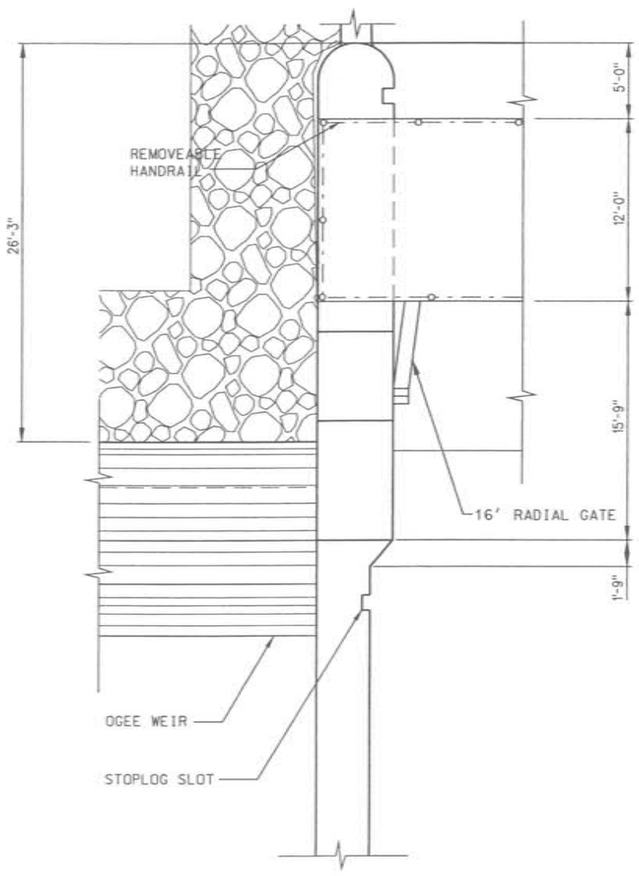
DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate30.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:21



DETAIL B
SCALE: 1" = 20' 30



DETAIL C
SCALE: 1" = 20' 30



DETAIL 1
SCALE: 1" = 10' 30

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U. S. ARMY ENGINEER DISTRICT, SEATTLE
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SEATTLE, WASHINGTON

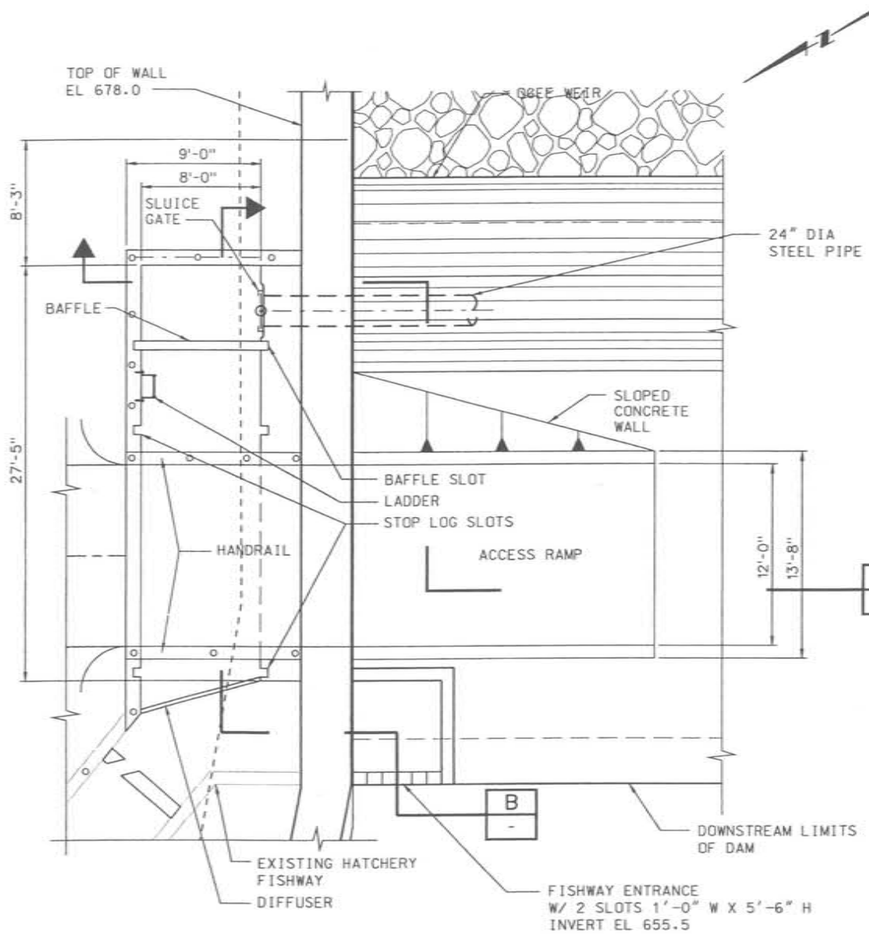
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
DAM SECTIONS 1

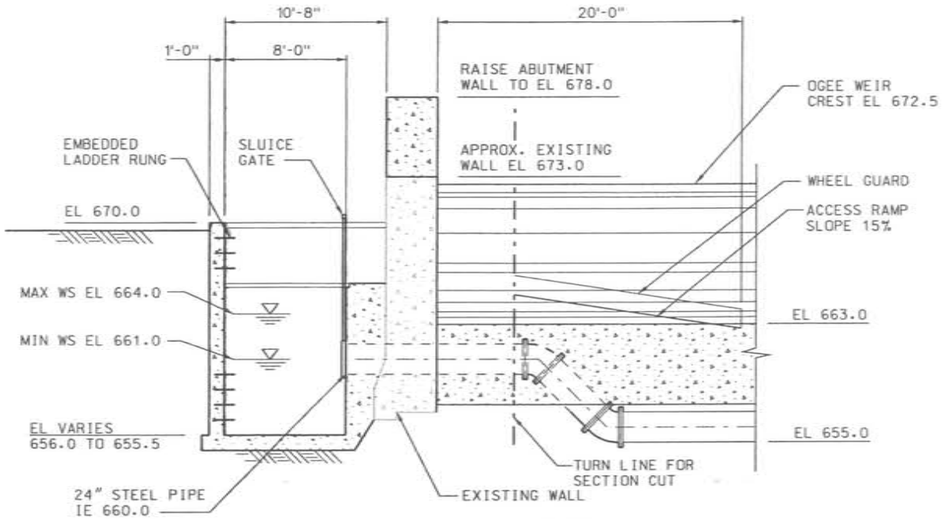
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		31

DSGN: F.E.P. | CHK: D.E.D. | SHEET OF 41

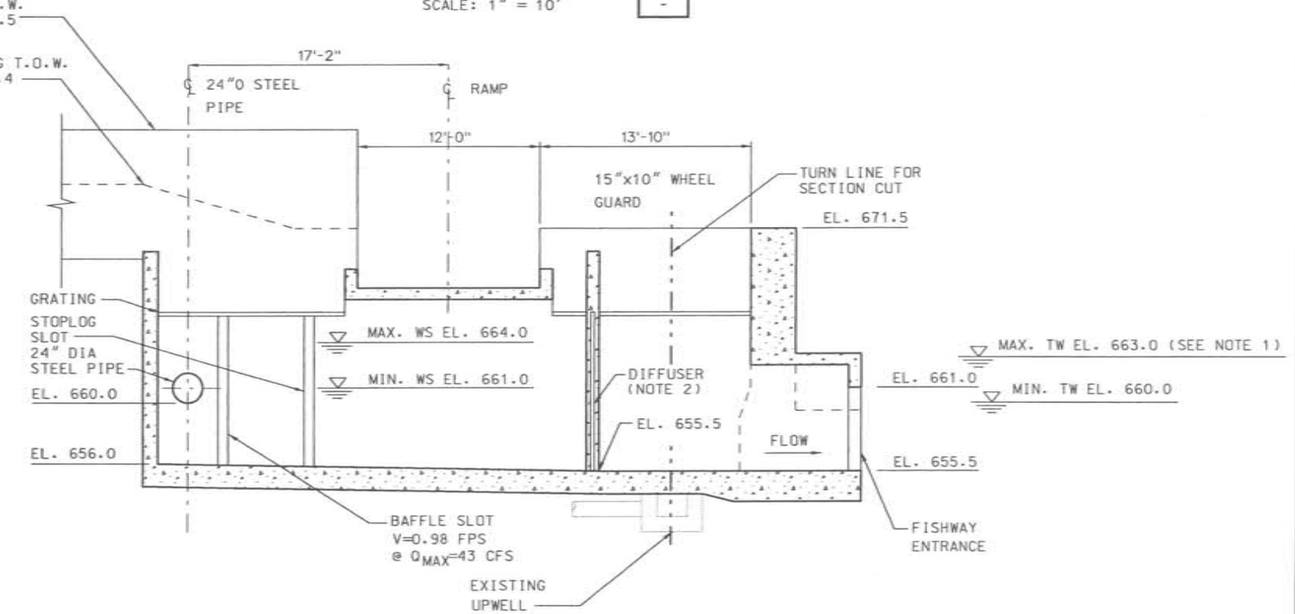
DESIGN FILE: \\Ussea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate31.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:21



DETAIL — SCALE: 1" = 10' — 2 / 30



SECTION — SCALE: 1" = 10' — A / -



SECTION — SCALE: 1" = 10' — B / -

NOTES:

1 MAXIMUM AND MINIMUM WATER SURFACE ELEVATIONS REFER TO THE RANGE OF ELEVATIONS FOR FISHERY CONCERNS, AND ARE NOT INTENDED TO REPRESENT HYDROLOGIC MAXIMUM AND MINIMUMS.

2 DIFFUSER WITH 1-INCH BAR SPACING AND AN APPROACH VELOCITY OF 1 FPS.

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U. S. ARMY ENGINEER DISTRICT, SEATTLE
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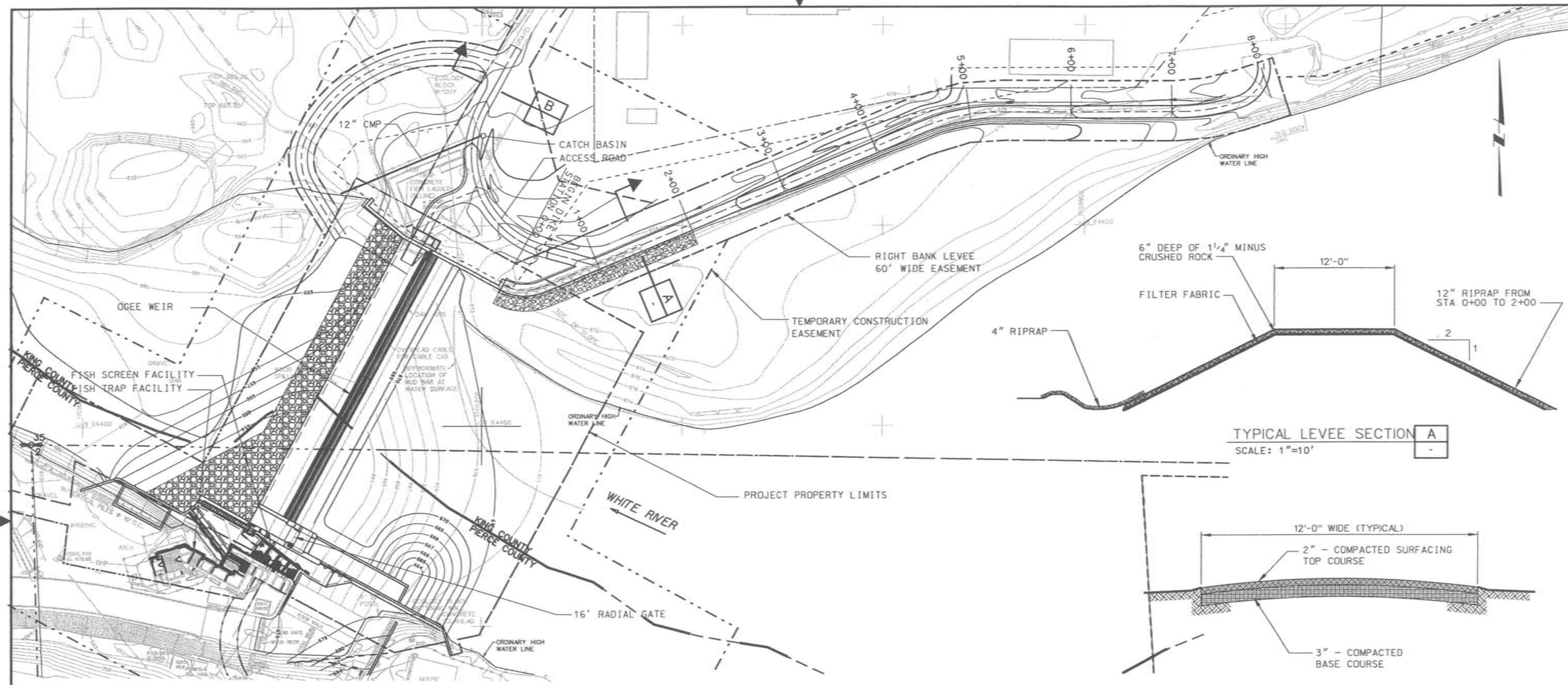
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE DAM SECTIONS 2

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		32

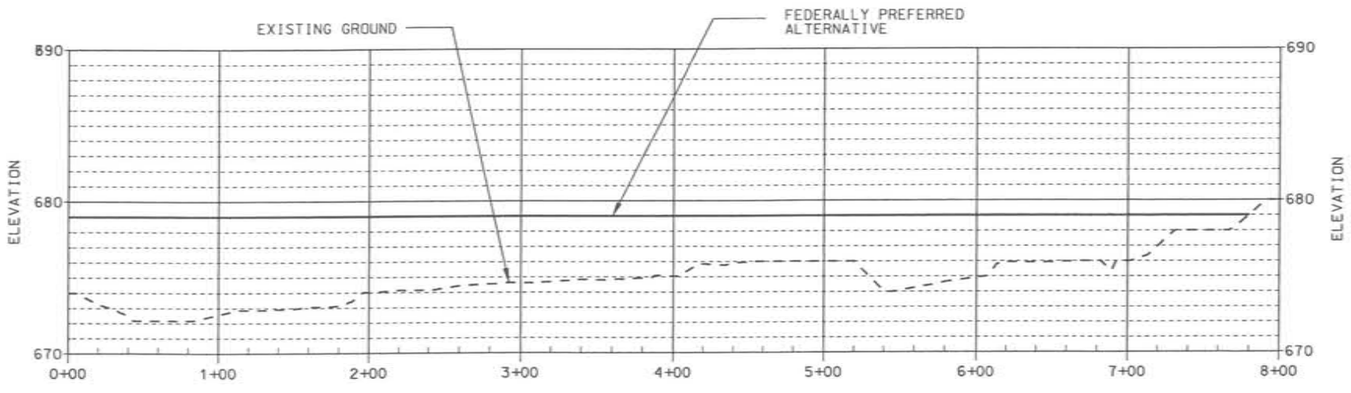
DSGN: F.E.P. | CHK: D.E.D. | SHEET OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate32.dg@ATE AND TIME PLOTTED: 30-DEC-2004 13:21



TYPICAL LEVEE SECTION | A | -
SCALE: 1"=10'

TYPICAL ROAD SECTION | B | -
NOT TO SCALE



LEVEE PROFILE
HORIZ SCALE: 1"=100' VERT SCALE: 1"=10'

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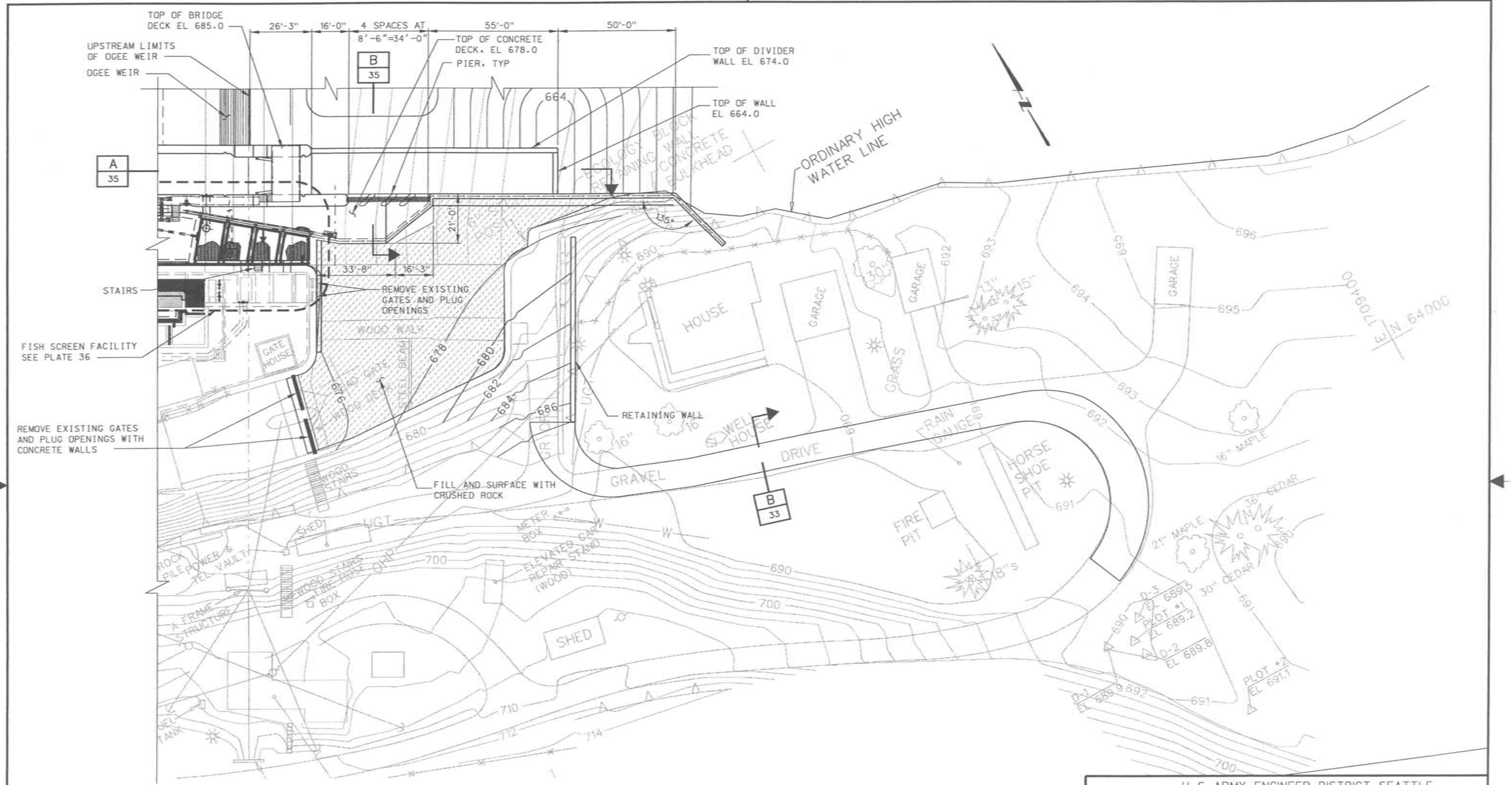
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PREFERRED ALTERNATIVE
LEVEE AND RIVER BANK PLAN
PROFILE AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B			33
DSGN: F.E.P.	CHK: D.E.D.	SHEET 33 OF 41	

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate33.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



INTAKE PLAN

SCALE: 1" = 40'

MWH

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

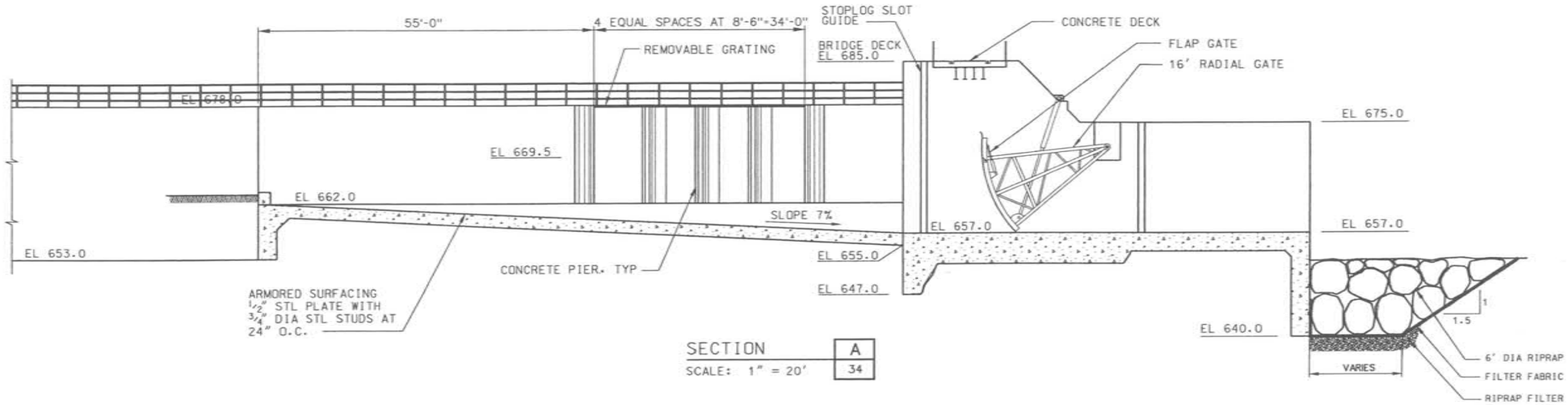
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
INTAKE PLAN

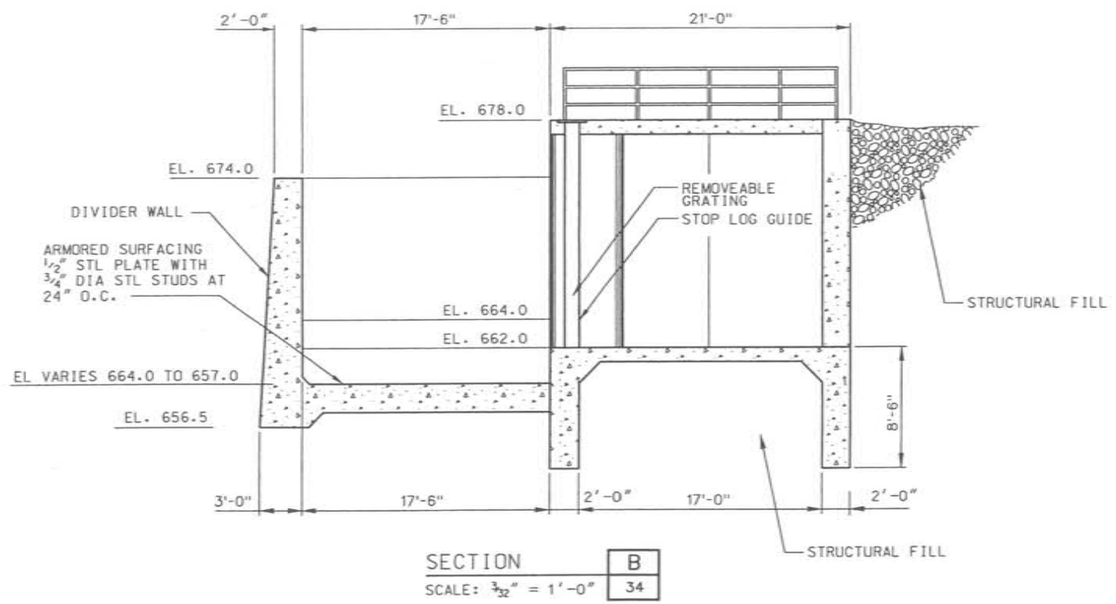
SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		34

DSGN: F.E.P. | CHK: D.E.D. | SHEET 34 OF 41

DESIGN FILE: \\Usseat501\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate34.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



SECTION A
SCALE: 1" = 20' 34



SECTION B
SCALE: 3/32" = 1'-0" 34

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

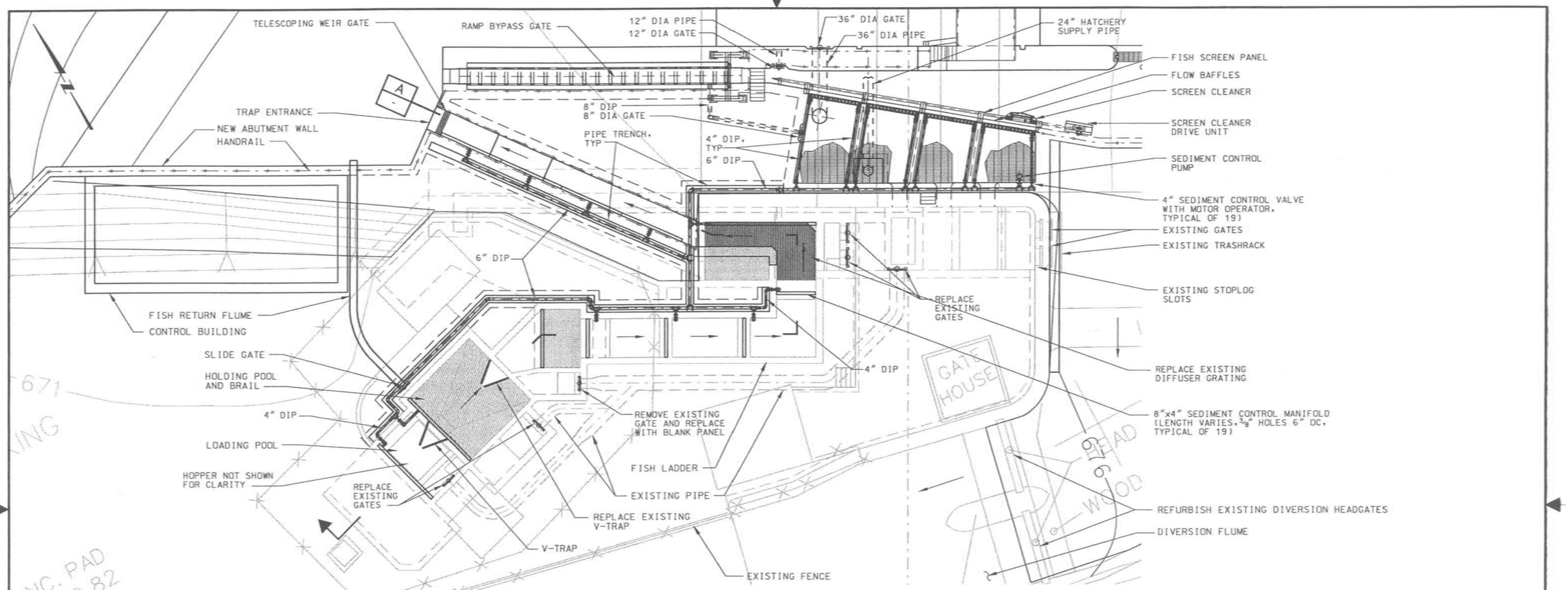
FEDERALLY PREFERRED ALTERNATIVE INTAKE SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		35

DSGN: F.E.P. | CHK: D.E.D. | SHEET 35 OF 41

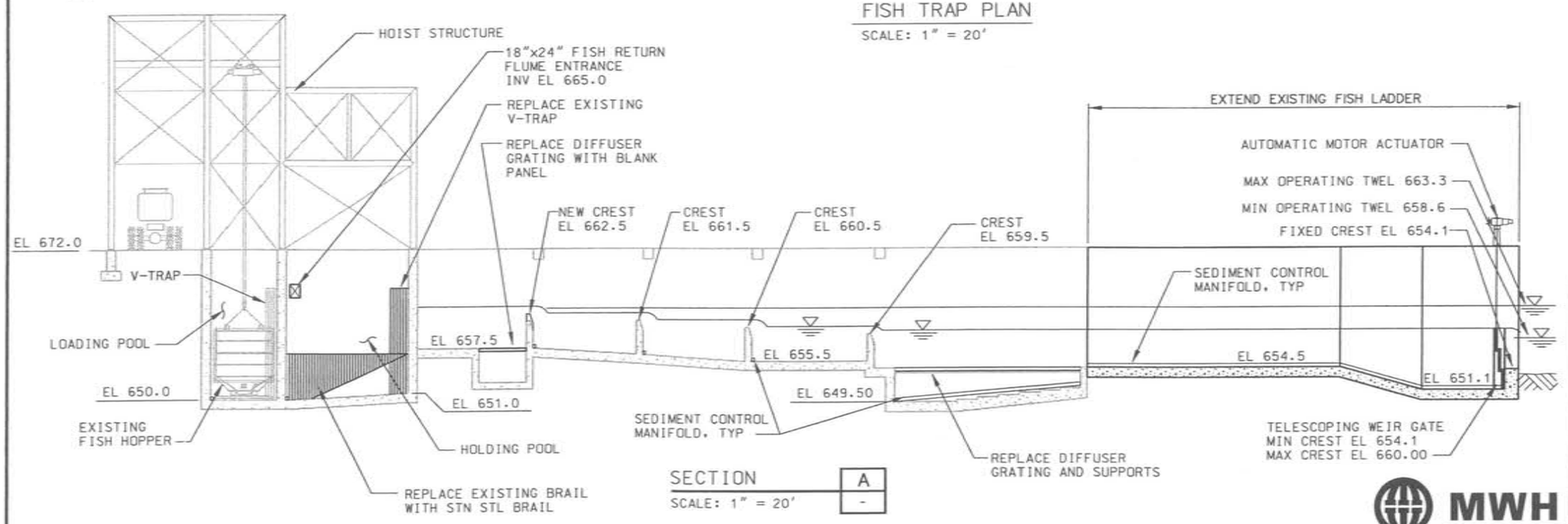
MWH

DESIGN FILE: \\Ussea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate35.dgn DATE AND TIME PLOTTED: 03-JAN-2005 09:34



FISH TRAP PLAN

SCALE: 1" = 20'



SECTION A

SCALE: 1" = 20'

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SEATTLE, WASHINGTON

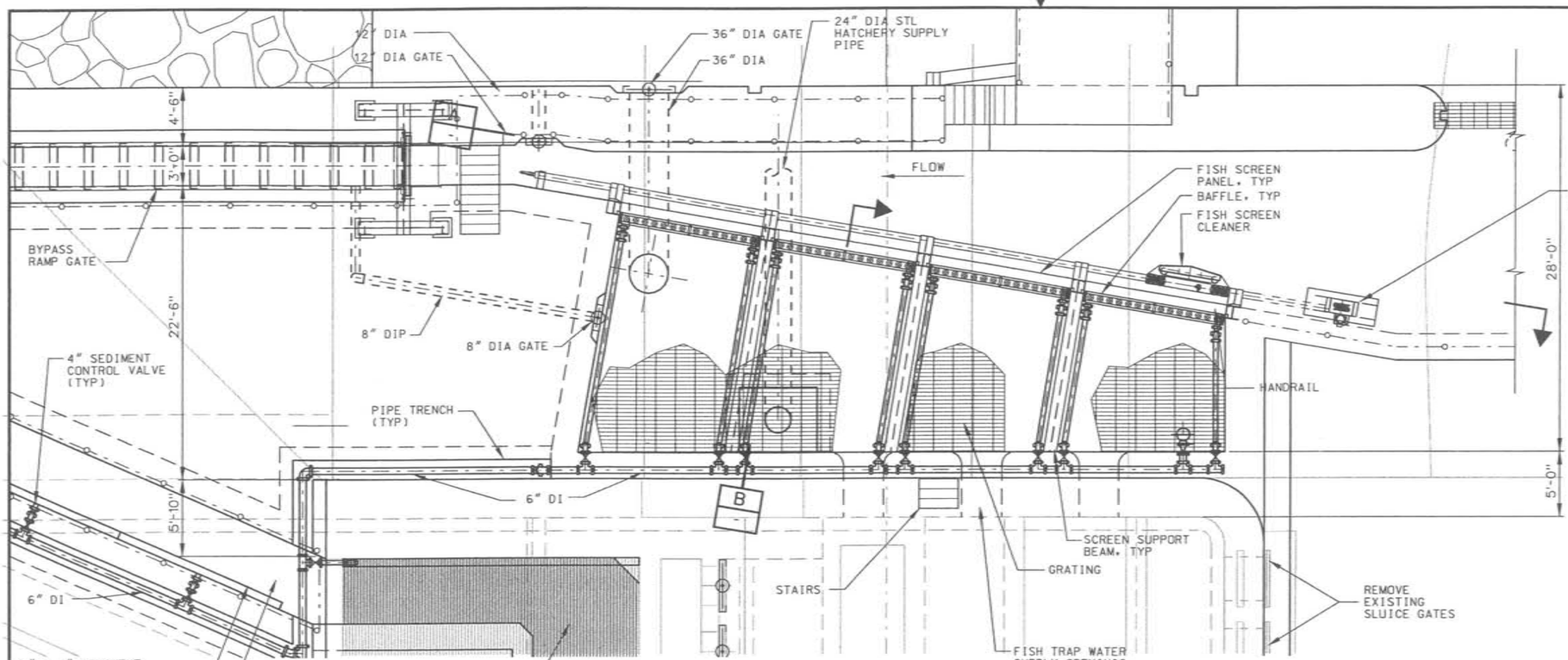
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
FISH TRAP PLAN AND ELEVATION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		36

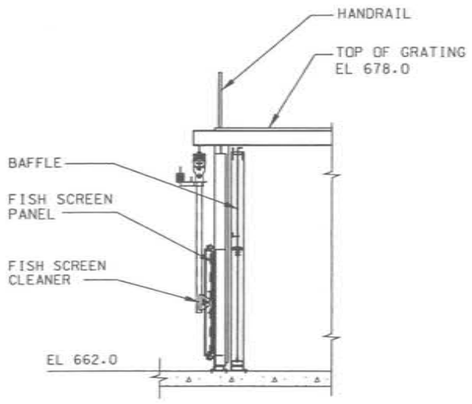
DSGN: F.E.P.	CHK: D.E.D.	SHEET 36 OF 41

DESIGN FILE: \\Usseas01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate36.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



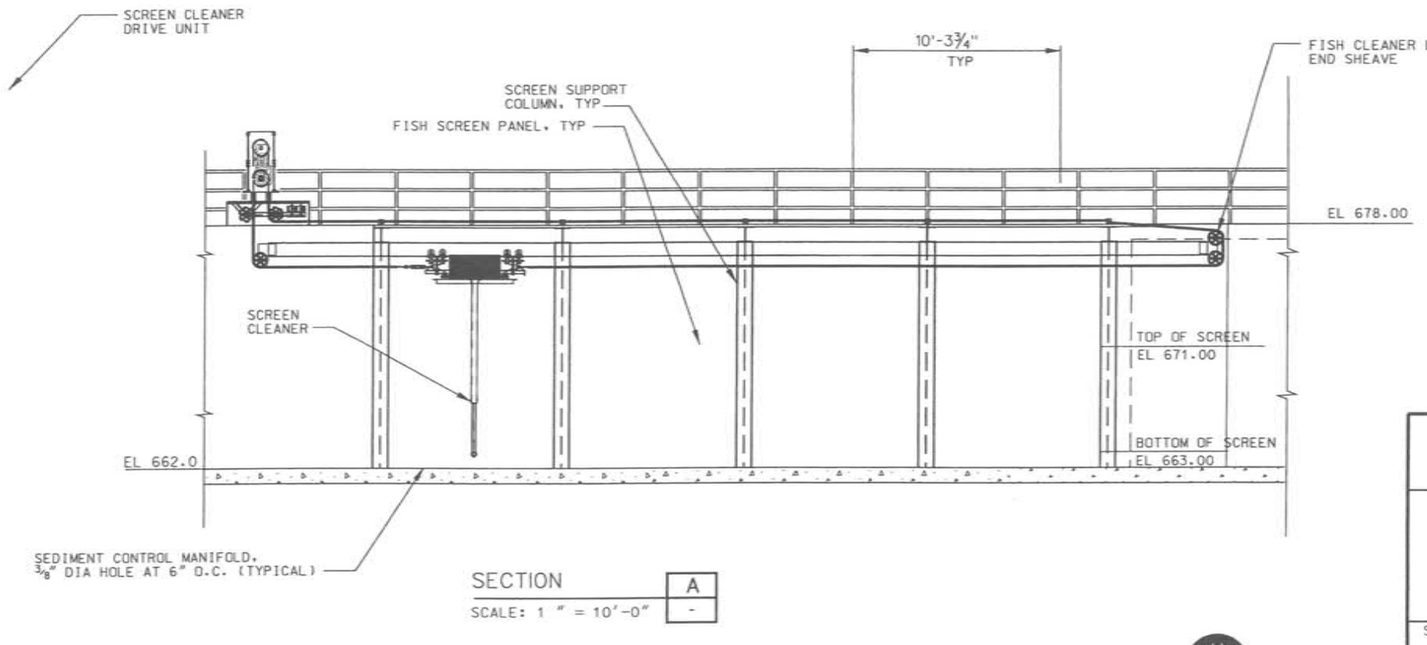
PLAN

SCALE: 1" = 10'-0"



SECTION B

SCALE: 1" = 10'-0"



SECTION A

SCALE: 1" = 10'-0"

U. S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

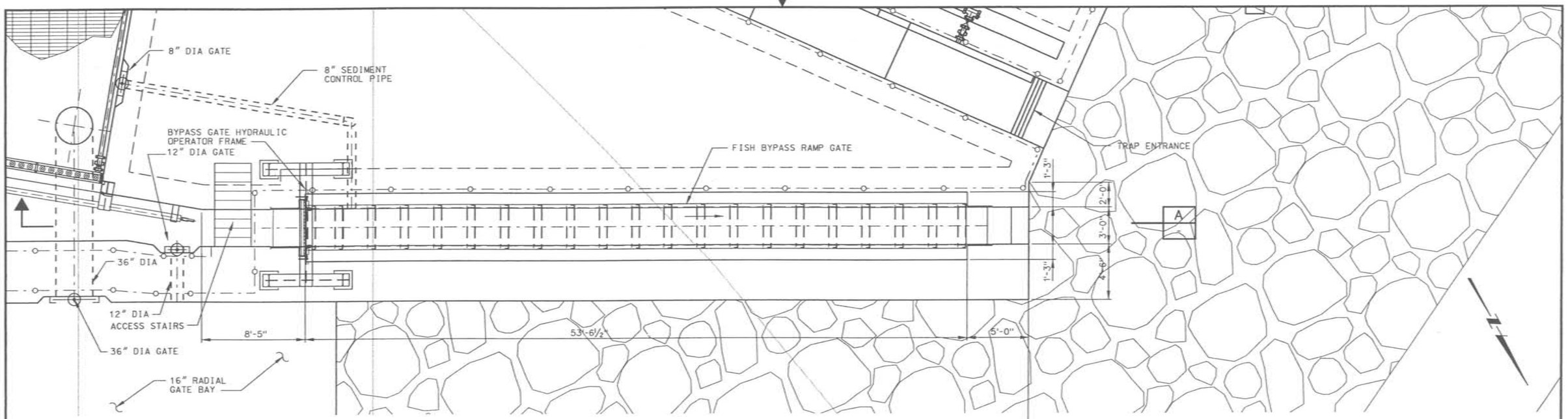
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PREFERRED ALTERNATIVE
FISH SCREEN
PLAN AND SECTIONS

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		37

DSGN: F.E.P. | CHK: D.E.D. | SHEET 37 OF 41

MWH

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate37.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



PLAN
SCALE: 1/8" = 1'-0"

MWH

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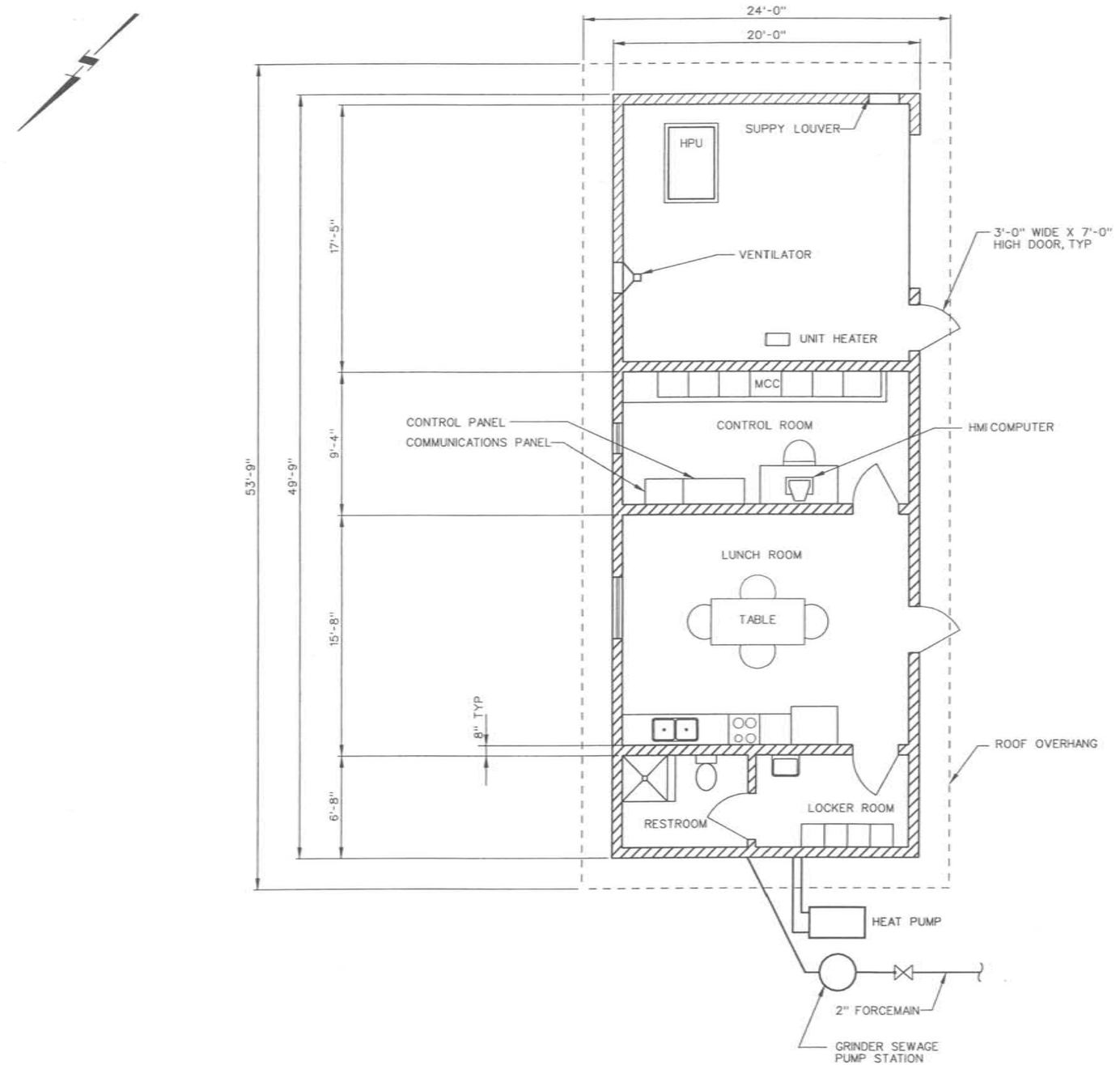
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PREFERRED ALTERNATIVE
BYPASS RAMP GATE
PLAN AND SECTION

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		38

DSGN: F.E.P.	CHK: D.E.D.	SHEET 38 OF 41

DESIGN FILE: \\Ussea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate38.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



PLAN
SCALE: 1/8" = 1'-0"

MWH

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SEATTLE, WASHINGTON

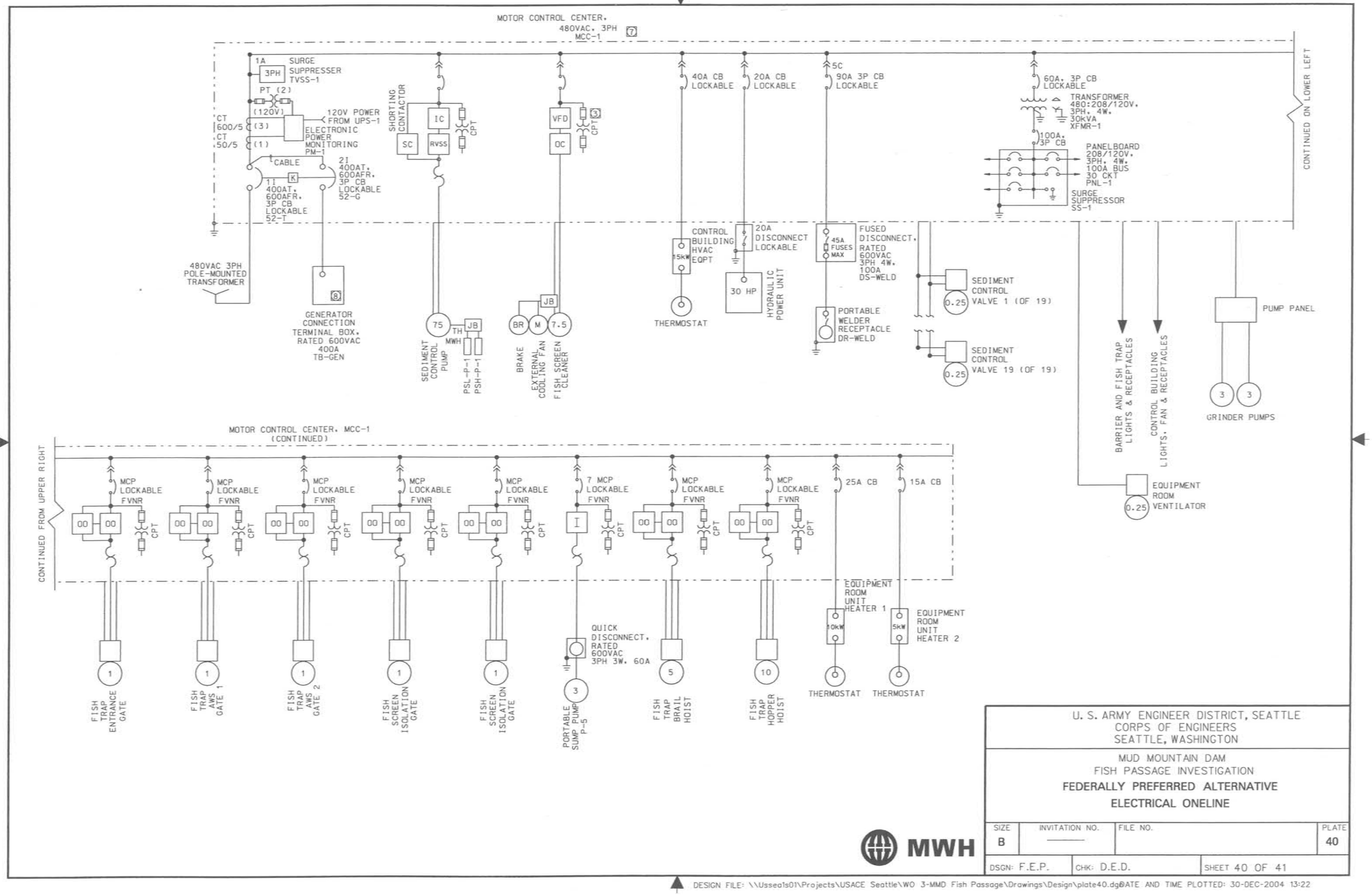
MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
CONTROL BUILDING PLAN

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		39

DSGN: F.E.P.	CHK: D.E.D.	SHEET 39 OF 41

DESIGN FILE: \\Usseals01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate39.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22



MWH

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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION
FEDERALLY PREFERRED ALTERNATIVE
ELECTRICAL ONELINE

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		40

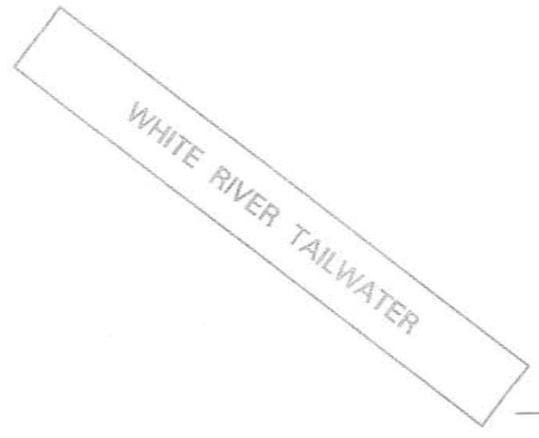
DSGN: F.E.P. | CHK: D.E.D. | SHEET 40 OF 41

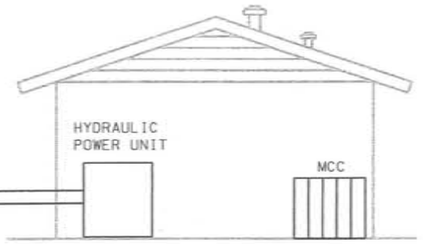
DESIGN FILE: \\Usseat1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate40.dgn DATE AND TIME PLOTTED: 30-DEC-2004 13:22

LEGEND:

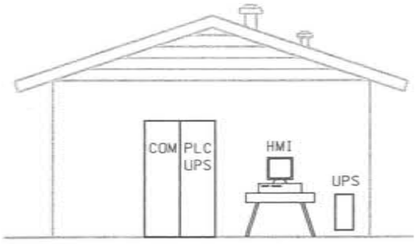
EQUIPMENT
MCC = MOTOR CONTROL CENTER
ME = MECHANICAL EQUIPMENT
P = PUMP

DEVICES
G = GAUGE
HMI = HUMAN MACHINE INTERFACE (OPERATOR INTERFACE/DISPLAY)
I/O = INPUT/OUTPUT (TO A DEVICE)
LSHH = HIGH HIGH LEVEL SWITCH
LSH = HIGH LEVEL SWITCH
LSL = LOW LEVEL SWITCH
LSLL = LOW LOW LEVEL SWITCH
LIT = LEVEL INDICATING TRANSMITTER
PG = PRESSURE GAUGE
PS = PRESSURE SWITCH
PT = PRESSURE TRANSMITTER
PLC = PROGRAMMABLE LOGIC CONTROLLER
M = MOTOR
UPS = UNINTERRUPTIBLE POWER SUPPLY
ZS = PROXIMITY SWITCH
ZT = PROXIMITY TRANSMITTER

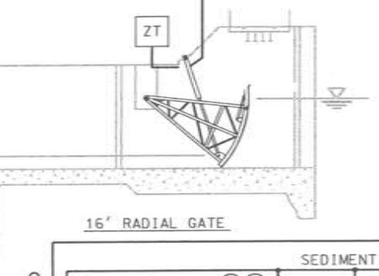




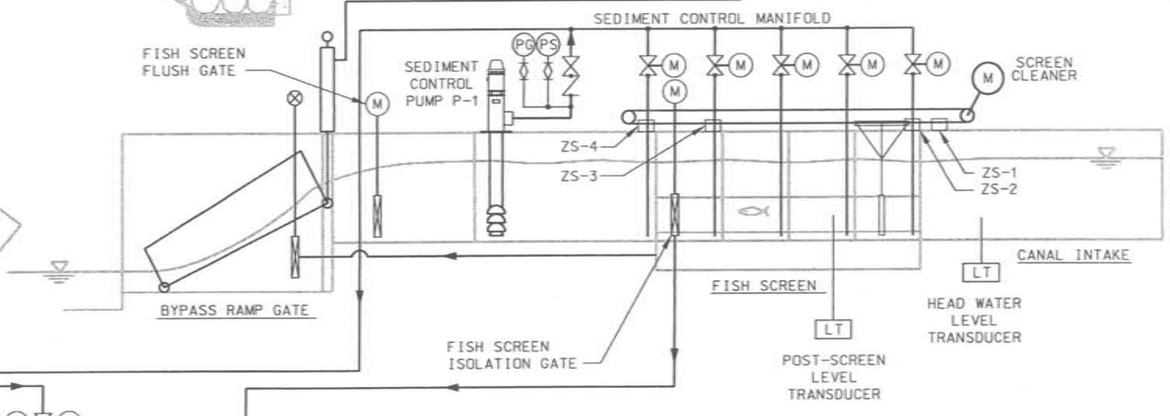
EQUIPMENT ROOM

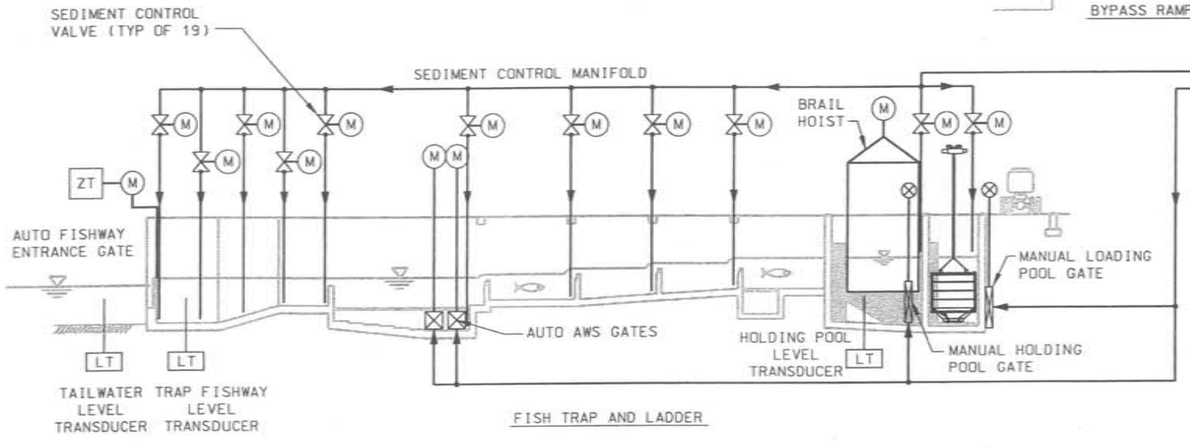


CONTROL ROOM



16' RADIAL GATE





FISH TRAP AND LADDER

MWH

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SEATTLE, WASHINGTON

MUD MOUNTAIN DAM
FISH PASSAGE INVESTIGATION

FEDERALLY PREFERRED ALTERNATIVE
FLOW DIAGRAM

SIZE	INVITATION NO.	FILE NO.	PLATE
B	———		41

DSGN: F.E.P. | CHK: D.E.D. | SHEET 41 OF 41

DESIGN FILE: \\Usea1s01\Projects\USACE Seattle\WO 3-MMD Fish Passage\Drawings\Design\plate41.dgrDATE AND TIME PLOTTED: 30-DEC-2004 13:19